## Draft Engineering Evaluation/Cost Analysis

# Little Squalicum Creek Site Bellingham, Washington

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## **Prepared for:**

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## ist of Abbreviations and Acronyms

ARAR Applicable or Relevant and Appropriate Requirement ATSDR Agency for Toxic Substances and Disease Registry

bgs below ground surface
BMP best management practice
BNSF Burlington Northern Santa Fe
BTC Bellingham Technical College

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

CFR Code of Federal Regulations

cfs cubic feet per second COB City of Bellingham

COPC contaminant of potential concern

cPAHs carcinogenic polycyclic aromatic hydrocarbons

CSL Cleanup Screening Level

CWA Clean Water Act CY cubic yard

DEA David Evans and Associates
DNAPL dense non-aqueous phase liquid

Ecology Washington State Department of Ecology

E & E Ecology and Environment, Inc.

EE/CA Engineering Evaluation/Cost Analysis

EPA United States Environmental Protection Agency

EPC exposure point concentration

EPH extractable petroleum hydrocarbon fraction

ERA ecological risk assessment
ESA Endangered Species Act
ESI Expanded Site Inspection
FID flame ionization detector

FS Feasibility Study

HDPE high-density polyethylene HHRA human health risk assessment IRIS Integrated Risk Information System

ITRC Interstate Technology and Regulatory Cooperation

LNAPL light non-aqueous phase liquid LOAEL lowest observed adverse effects level

LSC Site Little Squalicum Creek Site LSP Little Squalicum Park micrograms per liter

mg/L milligrams per liter mph miles per hour

MTCA Model Toxics Control Act NAPL non-aqueous phase liquid



NAVD 88 North American Vertical Datum of 1988

NCP National Oil and Hazardous Substances Pollution Contingency Plan

NES Northwest Ecological Services

NPDES National Pollution Discharge Elimination System

NPL National Priorities List

NWTPH Northwest Total Petroleum Hydrocarbon

Oeser Company

Oeser Site Oeser Company Superfund Site
OPC Olympic Portland Cement Company
PAHs polycyclic aromatic hydrocarbons

PCP pentachlorophenol
PID photoionization detector
PRSC Post-Removal Site Control

RAGS Risk Assessment Guidelines for Superfund

RAO removal action objective
RfD non-cancer reference dose
RI Remedial Investigation
ROD Record of Decision
RPF relative potency factor

SCEM site conceptual exposure model

SF cancer slope factor SIM selective ion monitoring

SMS Sediment Management Standards SQS Sediment Quality Standards SVOCs semivolatile organic compounds

TBC to be considered

TCDD tetrachlorodibenzo-p-dioxin TEF toxicity equivalency factor

TEQ toxic equivalency

TPAHs total polycyclic aromatic hydrocarbons

TPH total petroleum hydrocarbons U & I Utah and Idaho Sugar Company

UCL upper confidence limit

USACE United States Army Corps of Engineers

VOCs volatile organic compounds

VPH volatile petroleum hydrocarbon fraction

WAC Washington Administrative Code

WHO World Health Organization
WWTP Wastewater Treatment Plant

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## Introduction

The United States Environmental Protection Agency (EPA) directed Ecology and Environment, Inc., (E & E), through its contract with CH2M HILL (Contract No. 68-S7-04-01) and CH2M HILL's subcontract with E & E (Purchase Order No. 918385), to prepare this Engineering Evaluation/Cost Analysis (EE/CA) for the Little Squalicum Creek Site (LSC Site or Site) in Bellingham, Washington. Soil, sediment, surface water, and groundwater at the LSC Site contain chemicals that are associated with wood-treating operations. The Oeser Company (Oeser), an active wood-treating facility that has operated since the 1940s, has been identified as a source of some of these contaminants within the LSC Site. Soil and groundwater impacted by these contaminants on the Oeser facility are the subject of an ongoing cleanup action being implemented by Oeser, as directed by the EPA, and in accordance with the EPA Record of Decision (ROD) for the Oeser Company Superfund Site (Oeser Site) Remedial Action (EPA 2003). In addition to the releases on the Oeser property, Oeser-related contaminants have historically been discharged to the LSC Site via Oeser's stormwater drainage system. At the time the Oeser Site ROD (EPA 2003) was prepared, the EPA determined that the risk posed by Oeser-related contaminants within the LSC Site did not pose an unacceptable risk to human or ecological receptors, and that cleanup of Oeserrelated contaminants within the LSC Site was not warranted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Since that time, based on additional data, the EPA has determined that Oeser-related contamination within the LSC Site is subject to cleanup action under CERCLA. There are also other sources of contamination at the LSC Site, including non-Oeser stormwater runoff and possible spills and dumping. However, because of the EPA's existing settlement with Oeser, the EPA is addressing the area in the Little Squalicum Park (LSP) where Oeser-related contaminants are located.

This EE/CA was conducted in accordance with the criteria established under CERCLA, as well as sections of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) applicable to removal actions (40 Code of Federal Regulations [CFR] Section 300.415). Section 300.415(b)(4)(i) of the NCP requires that an EE/CA be completed for all non-time-critical removal actions. An EE/CA is an analysis of removal action alternatives for the Site. This EE/CA identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that may achieve them. This EE/CA also provides information about the nature and extent of



contamination and potential risks posed by the contaminants to human and ecological receptors. An EE/CA serves an analogous function to, but is more streamlined than, the remedial investigation/feasibility study (RI/FS) conducted for remedial actions. The EPA document *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993) was used in the preparation of this EE/CA.



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## Site Description and Background

This section is based predominantly on information obtained from the documents *The Oeser Company Superfund Site Remedial Investigation Report* (Oeser Site RI; E & E 2002a, and references therein) and *Little Squalicum Park Remedial Investigation*, *Bellingham*, *Washington—Draft Final Report* (LSP RI; Integral 2008, and references therein).

### 2.1 Site Location and Land Use

The LSC Site lies within the LSP, which consists of approximately 21 publicly owned acres in Bellingham, Washington. The focus of this EE/CA is limited to those areas of the LSC Site that may have been impacted by contaminants that are potentially attributable to the Oeser Site, although there are also other sources of contaminants, including stormwater runoff and possible spills, dumping, and fill materials. The areas impacted by Oeser-related contaminants are within and in the immediate vicinity of the present and historical channels of Little Squalicum Creek. The Oeser facility and LSC Site are depicted in Figure 1. Boundaries and ownership of properties within LSP and adjacent properties are shown in Figure 2.

The LSC Site is surrounded by properties under a variety of land uses, including industrial operations and residential use. The Site is bordered on the north by the Oeser facility; Ershigs, Inc.; and Morse Industrial Park. Beyond these facilities is the Birchwood neighborhood (residential). LSP is bordered by the Seaview Subdivision (residential) on the east and west, Bellingham Technical College (BTC) on the east, and Bellingham Bay to the south. A Burlington Northern Santa Fe (BNSF) railroad line runs through LSP parallel to the Bellingham Bay shoreline.

LSP is currently used for recreational activities such as dog-walking, running, and biking. It provides open space, wildlife habitat, and stormwater conveyance services that are important elements of the parks and public works infrastructure of the City of Bellingham (COB or "City") and Whatcom County ("County") area. In January 2010, COB completed the *Little Squalicum Park Final Master Plan* (COB 2010). The final plan was adopted by the COB City Council on January 11, 2010. The 2010 park plan updates the original Park Management Plan developed in 1990 (COB 1990). The new plan calls for enhancement of park activities, site restoration, and resource protection. The plan envisions incorporation and enhancement of features created as part of environmental



cleanup into the park ecologic framework, including landforms and hydrologic features such as Little Squalicum Creek and wetlands. The plan also provides a framework for immediate and long-range facility and site improvements as well as park operations and management. Implementation of the elements in the plan is contingent upon receipt of funding.

## 2.2 Site History

The first known land use at the LSC Site was by Edward Eldridge around 1853 under the 320-acre Eldridge Donation Claim (E & E 2002a). During the late 1800s and early 1900s, most of the area was used by the Eldridge family for dairy farming, ranching, and hay cropping (Integral 2008). The BNSF railroad line that extends along the shoreline of Bellingham Bay was first developed around 1888. The Eldridge family deeded portions of the uplands and tidelands to the Olympic Portland Cement Company (OPC) in 1911 (now the Lehigh Cement Company). These deeds included land for the pier and a railway extending along the west side of the Little Squalicum Creek ravine (E & E 2002a). The pier spur was used to transport processed cement products to barges moored offshore until the 1950s when an over-water pipeline was constructed to convey product directly from the plant to barges moored at the pier. An old pump house that supplied water from a spring on Little Squalicum Creek for cement plant use is located downstream of the Marine Drive Bridge stormwater outfall. The plant discontinued pumping of spring water in the 1950s. The 1911 deed also conveyed the more heavily used "plant spur" to OPC. The plant spur was used to transport coal from the Bellingham coal mine and limestone from a pit near Silver Creek to the OPC plant (Integral 2008).

In 1925, the Eldridge family sold the property now occupied by Oeser to the Utah and Idaho Sugar Company (U & I). The sale included a deeded easement to convey sugar-processing wastes through Little Squalicum Creek into the tidelands of Bellingham Bay (E & E 2002a). A center line traverse recited in the easement appears to mark the thalweg of the original creek channel (Integral 2008). Reportedly, the plant closed in 1942 (E & E 2002a). During the 1940s and 1950s, a commercial plant nursery was located to the west of Little Squalicum Creek on Marine Drive (Integral 2008).

Localized sand and gravel mining and sorting occurred in the park area between the 1910s and the 1960s (Integral 2008). In 1932, the Eldridge family granted the Marietta Township mining rights to the gravel within the ravine west of Marine Drive. From about 1961 until the late 1960s, sand and gravel were extensively mined by the Eiford family (E & E 2002a). Prior to about 1961 or 1962, when Little Squalicum Creek was first straightened, gravel mining occurred only at and downstream of a prominent bank feature extending south from the area where Krabbe Drive and the OPC pier spur intersect (Integral 2008). In some places within the ravine over 20 feet of native soils were mined for their sand and gravel. Some of the ditches that were excavated to facilitate drainage remain in place today (E & E 2002a). Much of Little Squalicum Creek's original course was diverted into these ditches. The entire ravine was altered substantially from natural conditions with rerouting of the original creek bed and significant changes



to the soils and lithology (e.g., backfilling of gravel pit and wash pond excavations, temporary road maintenance, and rail bed and track placement) (Integral 2008). Temporary basins were dug for gravel washing and reportedly filled with groundwater, both seasonally and, in some cases, year-round (E & E 2002a). The rerouting of Little Squalicum Creek to its current location occurred in 1961–1962 based on available aerial photos (Integral 2008). After mining, the land was leased to Mt. Baker Plywood for raw log storage during the early 1970s (E & E 2002a). Logs were transported to and from the ravine via the beach (Integral 2008).

In 1976, Whatcom County Park Board acquired 13 acres from the Eiford family, including the majority of the ravine. About 0.7 acre was sold to BTC by the County, partly in exchange for trail easements through the BTC campus (Integral 2008).

The Eldridge family deeded the tidelands onto which Little Squalicum Creek flows to the Port of Bellingham in 1927 (E & E 2002a). A 60-foot right-of-way west of the Marine Drive Bridge was deeded to the Port in 1956, but was never developed or used by the Port. The fee to this area (the Eldridge Heirs' Creek Parcel) was purchased by the City in 2001 from the Eldridge heirs (Integral 2008).

In 1977, the City constructed an underground storm drain through the upper part of the ravine. Stormwater from approximately 3 square miles of the Birchwood neighborhood, including the BTC parking lot, is conveyed through the storm drain and discharged into Little Squalicum Creek via the Birchwood/BTC stormwater outfall. Reportedly, since 2002, stormwater from the BTC parking lot has been directed through composted leaf media before being discharged into Little Squalicum Creek through the Birchwood/BTC stormwater outfall. Although water is diverted directly into the Birchwood neighborhood storm drain during larger rainstorms (defined as being larger greater than 6-month storms), reportedly most BTC runoff (approximately 90 %) flows through the composted leaf media before discharging to Little Squalicum Creek (Integral 2008). It was not determined during the development of this EE/CA whether the composted leaf media is monitored or maintained.

The City owns 8.7 acres of LSP and leases 12.3 acres of County-owned property at the Site. Currently, a lease agreement between the City Parks and Recreation Department and Whatcom County Parks Department stipulates that the City will manage and operate the area as a park site for 35 years (to about 2025), with a renewal provision for another 35 years. This lease was negotiated during the time of the EPA's investigation of the Oeser Site, which included portions of LSP. Due to evidence of contamination, the County retained liability for environmental issues as a provision of the lease (Integral 2008).

The Oeser Cedar Company (currently known as The Oeser Company) purchased the nearby U & I property in 1943 and has continuously manufactured poles for utility companies since that date. Records dating back to 1953 show that the process included segregating poles by length and class, incising some or all of the



poles, and subjecting them to "oil treatment." Finished poles were shipped offsite by rail on tracks adjacent to the OPC plant spur. Both pentchlorophenol (PCP) and creosote have been used as wood preservatives over the history of wood treating operations at the facility. The ranges of dates during which time creosote and PCP were used at Oeser for wood treating is unclear. PCP is currently the only preservative in use at the facility (E & E 2002a). A detailed description of the wood treatment processes used by Oeser is presented in the Oeser Site RI (E & E 2002a).

PCP is an EPA—restricted-use product used to protect wood from insect attacks and decay. PCP is formed by stepwise chlorination of phenols in the presence of catalysts. Impurities formed during the manufacturing process include chlorodiphenylethers, dibenzofurans, dibenzodioxins (dioxin), and various phenol isomers (EPA 1992). The solvent or carrier oil used in the PCP treatment process is described in its Material Safety Data Sheet as "Diesel No. 2," a complex (C9 to C20) organic petroleum (hydrocarbon) mixture containing less than 1% naphthalene with a specific gravity of 0.85 to 0.87 (E & E 2002a).

Creosote is an EPA—restricted-use product used as a preservative for wood, typically on marine pilings, railroad ties, and cross arms. Creosote is obtained through distillation of coal tar. The composition of creosote is highly dependent on coal composition, design and operating conditions of the coke oven, and design and operation of the distillation process. The composition of creosote used during past operations at the Oeser facility included greater than 5% each of the following compounds: naphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, and fluoranthene (E & E 2002a). Lesser percentages of other polycyclic aromatic hydrocarbons (PAHs) make up most of the remaining compounds in creosote. In general, PAHs account for 85% by weight of the chemical constituents in creosote (EPA 1992a).

Oeser has historically discharged process wastewater and stormwater to Little Squalicum Creek since wood-treating operations began in the late 1940s. These waters historically entered the Birchwood/Oeser storm drain, which originates in the Birchwood neighborhood northeast of the Oeser facility and runs southward beneath the Oeser facility, and discharges to Little Squalicum Creek through the Birchwood/Oeser storm drain outfall. The present Birchwood/Oeser storm drain follows the historical alignment of a drainage channel that was apparently filled during construction of the U & I sugar plant, or for the site's conversion by Oeser. The Birchwood/Oeser outfall is a short distance from the Birchwood/BTC outfall to the east. Discharges from Oeser have historically contained contaminants, including creosote, PCP, dioxins/furans (associated with PCP), diesel fuels, and related oil products.

In October 1974, Oeser was issued a National Pollution Discharge Elimination System (NPDES) permit (No. WA-000210-1) that allowed discharge of process wastewater to the COB Wastewater Treatment Plant (WWTP), with daily maximum limits of 100 milligrams per liter (mg/L) oil and grease, and 10 mg/L total phenols. A new permit was issued in June 1984, with an interim limit of



total oil of 100 mg/L discharged to the COB WWTP and an ultimate requirement of achieving zero discharge. The 1984 permit required implementation of an evaporative system to eliminate discharge of process wastewater containing wood preservative substances to state ground, surface, or COB WWTP waters. Zero discharge of process wastewater was achieved (Ecology 2006a).

Oeser was first issued a NPDES permit regulating stormwater discharges on June 30, 1993. This permit addressed contaminated stormwater that was running off the site and potentially infiltrating to ground water. The 1993 permit placed limitations on the storm water for oil and grease and pH. An interim limit of 215 micrograms per liter ( $\mu$ g/L) PCP was also listed. The original permit has been subsequently modified (Ecology 2006b). A subsequent permit that was issued on June 7, 2001 placed effluent limitations on oil and grease, PCP, and pH (Ecology 2006a). Oeser's current permit (No. WA 003081-3) was issued on September 28, 2006 (Ecology 2006a). As with previous permits, the current permit continues to disallow discharges of process wastewater, and places effluent limitations on stormwater discharges (daily maximum limits for PCP at 9  $\mu$ g/L and for oil and grease at 10 mg/L (Ecology 2006b).

Additional information on the wastewater/stormwater permit history for the Oeser facility is given in the Oeser Site RI and the Fact Sheet for NPDES Permit WA-003081-3 (Ecology 2006a).

Stormwater drainage from the Birchwood neighborhood (via the Birchwood/Oeser and Birchwood/BTC drainages as well as several small, localized stormwater outfalls) may also be a historical and current pathway for petroleum hydrocarbons, PAHs, and heavy metals to reach Little Squalicum Creek. A likely source of these contaminants is from motor vehicle and mixed commercial/residential use throughout this drainage area (Integral 2008).

## 2.3 Topography and Site Features

The base map used in the preparation of this EE/CA was created using data from a topographic survey completed by White Shield, Inc., in April 2008 (White Shield 2008). Topography and pertinent LSC Site features mapped as part of this survey are depicted in Figure 3 and described below.

Most of the LSC Site is located at the base of a forested ravine with steep sides and a generally level bottom. The top of the ravine is at approximately 65 feet North American Vertical Datum of 1988 (NAVD 88), and the bottom ranges from 20 to 30 feet NAVD 88. From its head, the ravine extends west–northwest for about 550 feet, and then turns to the southwest for about 700 feet, runs south–southwest for about 950 feet beneath the Marine Drive Bridge, and ends at Little Squalicum Beach on Bellingham Bay. The ravine bottom is primarily open meadow with deciduous forest representing a relatively young riparian environment.

The northwestern portion of the LSC Site (referred to as the South Slope in the Oeser Site RI and LSP RI) is located at the top of the ravine, level with the Oeser



facility. This area of the LSC Site contains a parking lot and two trailheads leading down into the ravine.

An active BNSF rail line runs east—west just north of the LSC Site and south of the Oeser property. A second active BNSF rail line runs southeast—northwest through the LSC Site along a railroad trestle, approximately 100 feet from the Bellingham Bay shoreline. Another rail line existed historically along the west side of Little Squalicum Creek; the former railroad grade has been converted to a gravel trail, and provides vehicle and pedestrian access to the Port of Bellingham pier (previously owned by OPC). A second gravel trail runs along the east side of the ravine from BTC to Bellingham Bay, where it joins with the gravel trail that runs along the west side of Little Squalicum Creek. A gravel access road enters into the ravine from Lindbergh Avenue immediately north of the Marine Drive Bridge, and joins the gravel trail that runs along the east side of Little Squalicum Creek.

Little Squalicum Creek presently originates at the 36-inch-diameter Birchwood/Oeser outfall, which discharges into a ravine south of the BNSF railroad tracks immediately north of the LSC Site. Little Squalicum Creek runs southward through the ravine for approximately 80 feet before it flows through a concrete box culvert beneath the former railroad grade (now a gravel trail). Upon discharging from the box culvert, Little Squalicum Creek flows approximately 80 feet further southward to its confluence with the flow discharging from the Birchwood/BTC outfall. Little Squalicum Creek then flows along the western edge of the ravine for approximately 1,500 feet and discharges to Bellingham Bay through a 48-inch concrete culvert. The Little Squalicum Creek channel ranges in width from approximately 3 to 6 feet, and water in the channel is generally less than 1 foot deep. The present and historical characteristics and hydrology of Little Squalicum Creek are discussed further in Section 2.6.

## 2.4 Geology

Soils at the LSC Site have been altered by multiple historical uses of the LSC Site, including open pit sand and gravel mining from the 1910s to the 1960s, log storage, and use as a municipal landfill. Locally, over 20 feet of native soils were mined for sand and gravel. The alignment of Little Squalicum Creek has been modified as part of the sand and gravel mining operations to facilitate drainage. Temporary basins were dug for gravel washing and reportedly filled with groundwater, both seasonally and, in some cases, year-round. As a result of the sand and gravel mining and subsequent modifications, the topography on the southeast side of Little Squalicum Creek is presently relatively flat and lower than on the northwest side of the creek (E & E 2002a).

A shell midden identified during the LSP RI on the northwest side of Little Squalicum Creek between the Marine Drive Bridge and the mouth of Little Squalicum Creek indicates that this area has not been disturbed (Integral 2008).



Based on numerous soil borings and test pits installed during the LSP RI and previous investigations, the lithology in the vicinity of the present Little Squalicum Creek channel appears to consist largely of many thin, discontinuous layers of sand and silt, with smaller amounts of gravel (Integral 2008). These materials may represent recent alluvium deposited by the creek and/or fill. Soils at several locations in the immediate vicinity of portions of Little Squalicum Creek and other areas appear to have been altered. The entire ravine has been altered substantially from natural conditions with rerouting of the original creek bed and significant changes to the soils and lithology (e.g., backfilling of gravel pit excavations, release of log storage debris, landfilling activities, temporary road maintenance, rail bed and track placement and subsequent track removal, and filling and paving of some areas). Temporary basins were dug for gravel washing; these basins were reportedly filled seasonally, and in some cases yearround, with water. Subsequent to sand and gravel mining, the land was leased by Mt. Baker Plywood for log storage during the early 1970s (Springwood 1992, URS 1994, EPA 1997a, E & E 2002a).

Obvious indications of alterations of site soils include the spoils piles generated during excavation of the present creek channel. These elongated piles are located along both sides of the present creek channel for several hundred feet downstream of the area of the Birchwood/BTC storm drain outfall. Other indications of modification of site soils include the presence of fill material at depth (including material identified as fill in soil boring logs included in the LSP RI, and as inferred).

Undisturbed soils north of the ravine consist predominantly of gravel and sand, likely very similar to the materials targeted by the historical sand and gravel mining operations. These materials also are likely similar to those underlying the Oeser facility. The soil underlying the Oeser facility are Pleistocene glacial outwash deposits resulting from a series of glaciations that occurred between 10,000 and two million years ago. Three geologic zones comprise the outwash deposits. An "upper sandy zone" occurs typically from land surface to a depth of 20 or 25 feet and is predominantly fine to medium sand with laterally discontinuous lenses of silt and clay. A "gravelly zone" occurs below the upper sand zone and is composed of gravel and sand, with minor pure sand, silt, and clay lenses. The gravelly zone is 25 to 40 feet thick where it has been penetrated locally. A "lower sandy zone" is present below the gravelly zone. The top of this zone is encountered at depths of 40 to 50 feet below ground surface (bgs) and is composed of poorly graded fine to medium sand with silt and clay (E & E 2002a).

Clay units have been identified at several locations across the LSC Site (see soil boring logs in the Oeser Site RI and LSP RI). Several of these clay units appear to be present as layers that are laterally continuous over portions of the site. Where the clay layers are observed, their top surfaces occur at fairly regular and predictable elevations. One or more of these clay units was not encountered in several soil borings at the anticipated elevation. The apparent absence of such clay units at these locations suggests that clay units have been removed at those



locations, possibly as a result of land modifications during sand and gravel mining operations.

## 2.5 Hydrogeology

The LSC Site hydrogeologic framework is based on data collected primarily during the Oeser Site RI and the LSP RI. The primary groundwater zone within the LSC Site correlates with the "deep aquifer" beneath the Oeser facility.

Groundwater occurs beneath the Oeser facility in two zones. Shallow perched groundwater occurs at a depth of 4 to 15 feet bgs in the "upper sandy zone." Shallow groundwater is characterized by discontinuous saturation that is perched on layers of fine-grained material. The shallow groundwater locally migrates downward to the underlying aquifer ("deep aquifer"), which generally occurs at a depth of 30 to 45 feet bgs at the Oeser facility. This "deep aquifer" at the Oeser facility is composed of coarser, more permeable material (consisting of the "gravelly zone" and the "lower sandy zone"), and is continuously saturated. Groundwater in the "deep aquifer" at the Oeser facility flows generally toward the southwest, and discharges to Little Squalicum Creek and Bellingham Bay (E & E 2002a).

During the Oeser RI, groundwater elevations were measured in three monitoring wells installed within the LSC Site as part of the Oeser RI (MWLSC-01, MWLSC-02, and MWLSC-03) in September 1999, December 1999, and February 2000. During the LSP RI, groundwater elevations were measured in two of these wells (MWLSC-02 and MWLSC-03) and new monitoring wells were installed as part of the LSP RI in February 2006 and May 2006. Within the LSC Site, groundwater is generally present from approximately 0 to 8 feet bgs near and to the southeast of Little Squalicum Creek. It should be noted that groundwater elevation data for well MWLSC-03 used in this EE/CA are based on the surveyed well elevation reported in the LSP RI (53.65 feet NAVD 1988); this re-surveyed elevation is 3.48 feet higher than the elevation reported for this well in the Oeser RI.

In May 2006, groundwater elevations ranged from 43.83 feet at upgradient well MW06D, located north of the Oeser property, to 11.82 feet NAVD 88 at downgradient well SB-18 (Integral 2008). The hydraulic gradients and flow directions in the "deep zone" groundwater (i.e., the groundwater zone present at the LSC Site) observed during the LSP RI (Integral 2008) are generally similar to those reported for the Oeser facility (E & E 2002a). Groundwater flow was generally to the southwest toward Bellingham Bay, with local variations on the southeastern side of the creek north of the Marine Drive Bridge (Integral 2008). In May 2006, hydraulic gradients ranged from approximately 0.01 northeast of the LSC Site to approximately 0.017 across the LSC Site. The lowest hydraulic gradient was between wells LSCMW-2 and SB-24.

Measured groundwater elevations were typically highest in the February reporting period(s), and lowest in September for wells monitored that month. For wells monitored only in February and May 2006, the groundwater elevations in



February were generally slightly higher (up to 0.81 feet) than in May; the hydraulic gradients and flow directions were similar to those in May 2006 (Integral 2008). The difference between the highest and lowest measured water elevations was less than one foot for all wells except for MWLSC-03, in which the February 2006 groundwater elevation was 2.64 feet higher than the September 1999 elevation.

Two springs on the north side of Little Squalicum Creek may have been tapped and used for the historical cement plant operations (E & E 2002a).

Groundwater within the LSC Site is not used for drinking water. The nearest known wells are on Tilbury Cement (formerly the Columbia Cement Company) property (E & E 2002a). These wells are approximately 2,000 feet west of, and cross-gradient to, the LSC Site.

## 2.6 Surface Water Hydrology

Little Squalicum Creek is the primary surface water feature at the LSC Site. Other surface water features consist of seeps and springs, wetlands, and ponds. These features are discussed below.

#### **Little Squalicum Creek**

Based on review of historical aerial photographs and a 1908 topographic map, in the early 1900s, prior to development of the surrounding area, Little Squalicum Creek flowed from its original headwaters (approximately 2 miles north of the LSC Site) generally southward to the area of the parking lot at BTC (see Figure 2). From there, the original creek flowed northwest toward the area of the Birchwood/BTC outfall, then flowed generally south before turning west toward the Marine Drive Bridge. From the Marine Drive Bridge area, the original creek flowed generally southwest to Bellingham Bay. The original creek channel was historically incised into an otherwise generally flat landscape. Subsequent sand and gravel mining removed much of the material that comprised the walls of the original creek ravine. The approximate boundaries of the original creek channel between the area of the Birchwood/BTC outfall and the Marine Drive Bridge is illustrated in Figure 4-1 of the LSP RI, and is adopted for the purposes of this EE/CA. This stretch of the original creek channel is referred to as the "historical creek channel" hereafter in this EE/CA.

At some time after 1908, the flow of the upper reach of Little Squalicum Creek was diverted to Squalicum Creek, which is approximately 0.5 mile south of Little Squalicum Creek (see Figure 1). Within the area of the LSC Site, Little Squalicum Creek was rerouted from its historical channel in the early 1960s, apparently to facilitate gravel mining in areas north of the Marine Drive Bridge. The historical channel north of the Marine Drive Bridge was abandoned, and a new, relatively straight channel along the base of the present western edge of the ravine was excavated. The present alignment of the creek is illustrated in Figures 2 and 3. Soil excavated to create the new channel was placed in spoils piles on either side of the new channel, though mainly on the east side, apparently because



of limited space on the west side. An ephemeral wetland currently exists in the location of the historical creek channel (E & E 2002a).

As a result of the diversion of the upper Little Squalicum Creek to Squalicum Creek some time after 1908, the flow in Little Squalicum Creek was significantly reduced (E & E 2002a). The present sources of water to Little Squalicum Creek include stormwater drainage, base flow from groundwater seeps, spring discharges, and direct precipitation.

#### **Stormwater**

Little Squalicum Creek is directly fed by four storm drain outfalls identified during the Oeser Site RI: the Birchwood/Oeser outfall, the Birchwood/BTC outfall, the Marine Drive outfall, and an outfall approximately 250 feet downstream of the Marine Drive Bridge. Presently, Little Squalicum Creek receives the majority of its inflow from the Birchwood/BTC, Birchwood/Oeser, and Marine Drive outfalls (E & E 2002a).

The Birchwood/Oeser storm drain serves both the Oeser facility and the Birchwood neighborhood to the north. The Birchwood/BTC storm drain serves a mixed industrial and residential area, and includes the BTC parking lot (E & E 2002a). The Marine Drive outfall is immediately north of the Marine Drive Bridge and conveys stormwater from Bennett Drive and the Birchwood neighborhood (Integral 2008). Information is not available on the drainage area of the fourth outfall, downstream of the Marine Drive Bridge.

Three additional storm drain outfalls discharging into the Little Squalicum Creek ravine were identified during the LSP RI. These outfalls do not discharge directly to the existing creek channel, but ultimately contribute to the flow within the creek. Two of the outfalls are just north of Lindbergh Avenue and discharge to the area of the historical creek channel. These outfalls are reported to be connected to catch basins on Lindbergh Avenue and a portion of BTC. The third additional outfall is located near the BTC parking lot and periodically discharges stormwater into the permanent wetland in the northeast area of the LSP (Integral 2008).

#### **Springs**

Additional flow in the lower reach of Little Squalicum Creek is contributed by two tapped springs on the west side of Little Squalicum Creek. One is approximately 50 feet upstream from the Marine Drive Bridge and the other is approximately 250 feet downstream from the bridge (Figure 3). A small building is the remains of the old pump house for the second tapped spring. These springs were used as a water source for the nearby cement plant until sometime in the 1950s, when they were disconnected from the cement plant's water supply system and allowed to drain directly down the side of the ravine into Little Squalicum Creek (E & E 2002a).

#### **Groundwater Baseflow**

The "deep aquifer" (as described in the Oeser Site RI) that underlies the Oeser facility discharges to Little Squalicum Creek downstream of where the creek



transitions from a losing stream to a gaining stream (E & E 2002a). Based on available groundwater elevation data provided in the Oeser RI and LSP RI and the surveyed elevation of the channel of Little Squalicum Creek, it appears to be a gaining stream for most of this length downstream of the Birchwood/BTC outfall during the wetter months (based on December 1999, February 2000, February 2006, and May 2006 groundwater elevations). Based on the comparison of groundwater elevations in monitoring well MWLSC-03 (25.78 feet NAVD 88) and stilling well LSC-SW-1 (26.52) in September 1999, the creek appears to be a losing stream in its upper reach during drier periods.

#### Water Budget

A mass balance of surface and storm drain water flowing into and out of Little Squalicum Creek was conducted as part of the Oeser Site RI. Results indicated that during the dry season, tapped spring flows account for about one-third of the flow within the creek. During the rainy season, nearly all flow within the creek could be traced back to stormwater runoff entering the creek through the Birchwood/Oeser storm drain, the Birchwood/BTC storm drain, and the Marine Drive storm drain outfalls (E & E 2002a).

#### **Ponds**

Several elongated, apparently perennial ponds lie adjacent to the north wall of the ravine between the Birchwood/BTC outfall and the BTC parking lot. These ponds were likely created during gravel operations to capture groundwater to alleviate flooding on the ravine bottom (E & E 2002a).

#### Wetlands

According to the Northwest Ecological Services (NES) document *Wetland Reconnaissance and Existing Conditions Report* (NES 2009), there are 14 wetlands at the LSC Site, including palustrine emergent, palustrine scrub/shrub, and palustrine forested vegetation classes and permanently inundated, seasonally inundated, and seasonally saturated hydrologic regimes. Using Ecology rating forms, 13 of the 14 wetlands are rated as Category III. The wetland in the area of the proposed estuary is rated as Category II (NES 2009). The approximate wetland boundaries depicted in Figure 9 of the document *Wetland Reconnaissance and Existing Conditions Report* (NES 2009) were geo-referenced in GIS and imported into AutoCAD Civil 3D for incorporation into Figure 3 of this EE/CA. The wetland boundaries depicted in Figure 3 are only approximate.

## 2.7 Sensitive Species and Environments

The LSC Site contains upland, lotic, palustrine and intertidal habitats (Integral 2008). Two Federal listed species, the bald eagle (*Haliaeetus leucocephalus*) and the bull trout (*Salvelinus confluentus*), may be present in the Site vicinity. In addition, five species of concern may be present in the Site vicinity, including the Pacific lamprey (*Entosphenus tridentata*), river lamprey (*Lampetera ayresi*), longeared myotis (*Myotis evotis*; a bat), long-legged myotis (*Myotis volans*; a bat), and peregrine falcon (*Falco peregrinus*). However, none of these species have been documented at the LSC Site (E & E 2002a). Sensitive species and environments present at the LSC Site are discussed below.



The upland habitat characterizes the majority of the LSC Site, including the northwestern portion (previously referred to as the South Slope in the Oeser Site RI). The upland habitat is vegetated with various grasses, wildflowers, horsetails (*Equisetum spp.*), blackberry (*Rubus spp.*), dogwood (*Cornus spp.*), hawthorne (*Cartaegus spp.*), alder (*Alnus spp.*) trees and saplings, and cherry (*Prunus spp.*) trees and saplings. The area provides cover, shelter, and food for wildlife. Several species of birds and mammals were observed in this area, including the American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), swallows, rabbits, squirrels, and deer (E & E 2002a). Barred owls and raccoons were also observed during 2005 and 2006 LSP RI site visits (Integral 2008).

The lotic area of the LSC Site is defined by the Little Squalicum Creek channel. Benthic invertebrates were observed in Little Squalicum Creek during collection of water and sediment samples for the Oeser Site RI. Amphipods, snails, and caddisfly larvae (Order Trichoptera) were observed in areas with noticeable current and gravel substrate. In areas with low flow and a muddy bottom, midge larvae (Family Chironomidae) and aquatic oligochaetes were observed. Aquatic insects include water striders (family Gerridae) and mosquitoes (family Culicidae). Use of Little Squalicum Creek by fish is thought to be limited, though salmon fingerlings have been spotted periodically in Little Squalicum Creek's lower reaches (E & E 2002a).

The channel of Little Squalicum Creek is shaded by a well-developed overstory of alder (*Alnus spp.*), willow (*Salix spp.*), and black cottonwood (*Populus trichocarpa*) trees. Common plant species in the understory include grasses; horsetail; blackberry; hawthorne; holly (*Ilex spp.*); and saplings of alder, willow, cottonwood, mountain ash (*Sorbus spp.*), fir (*Abies spp.*), and cedar (*Thuja spp.*). The creek and its riparian zone provide cover, shelter, food, and water for wildlife (E & E 2002a). Additional species identified during the LSP RI include sycamore maple and bigleaf maple trees; and the less common species of cherry laurel, western red cedar, and *Viburnum* sp. (Integral 2008).

Much of the lower area of the LSC Site comprises palustrine wetlands. Vegetation noted in the LSP RI included ferns, morning glory, and various herbaceous pioneer species. Several invertebrate species were observed, including arthropods such as insects, spiders, millipedes, earthworms, and other soil invertebrates. Although public footpaths cross the palustrine areas of the LSC Site, many areas remain undisturbed and likely provide cover, food, and shelter to a variety of avian and mammalian wildlife. Species reported or seen in the palustrine area include Cooper's hawks (*Accipiter cooperii*), barred owls (*Strixvaria*), crows (*Corvus brachyrhynchos*), gulls (family Laridae), American robins and other song birds, deer, raccoons, and squirrels (Integral 2008).

The LSC Site is bordered by the intertidal beach habitat and saline water of Bellingham Bay, adjacent to the Site. This beach is characterized by a gravelly substrate and it supports backshore grasses, forbs, and willow (probably *Salix* 



*alba*). Eelgrass (*Zostera marina*) grows in the intertidal sediments directly offshore. The trees and nearby concrete company dock provide perches for several bird species, including gulls, terns, crows, songbirds, and swallows (Integral 2008).

## 2.8 Meteorology

The climate of Bellingham is influenced largely by its location between the Olympic Mountains and Vancouver Range to the west and the Cascade Mountain Range to the east, as well as its location on the Georgia Strait. The source of most air masses is over the Pacific Ocean, which has a moderating effect on both summer and winter climate. The monthly average maximum temperature for December, historically the coldest month of the year, is 43.9°F. The average December minimum is 29.7°F. August, the warmest month of the year, has an average maximum of 73.9°F with an average minimum of 47.2°F (E & E 2002a).

Precipitation averages 0.99 inches per month in July, the driest month, and 4.89 inches in the wettest month, December. Average annual precipitation is 33.59 inches. The greatest monthly precipitation recorded was 11.71 inches, and the lowest monthly total was 0 inches. The greatest 24-hour rainfall event was 2.95 inches. Measurable snowfall occurs between November and March and totals an average of 9.7 inches per year. Summer winds are predominantly from the southwest, with winter winds more variable from the south and east. The average annual winds are predominantly (approximately 48% of the time) from the southwest to southeast and generally range from 4 to 15 miles per hour (mph). Winds are calm (less than 3 mph) about 21% of the time. Wind speeds in excess of 15 mph occur less than 10% of the time (E & E 2002a).

## 2.9 Previous Investigations

Little Squalicum Creek and its surrounding area has been the subject of 10 previous investigations. The following subsections describe the purpose of these investigations, identify the number and types of samples collected, and summarize the findings of data quality and usability evaluations conducted as part of the Oeser Site RI and LSP RI.

For use in the LSP RI, Integral compiled all of the useable data into a LSC Site master database, which was provided to E & E. E & E evaluated those data and used them, as appropriate, for this EE/CA. These data are summarized in tables provided in Appendix A. Figure 4 depicts all of the LSC Site sample locations for which soil and sediment sample analytical data were used. Figure 5 depicts all of the LSC Site sample locations for which groundwater, surface water, and seep or spring water sample analytical data were used.

#### 2.9.1 Site Inspection (E & E 1987)

Sediment, surface water and groundwater samples were collected in 1987 as part of an Oeser site inspection performed for EPA. Volatile organic compound (VOC) and semivolatile organic compound (SVOC) analyses were performed (E & E 1987). A data quality summary presented in the Oeser Site RI indicated



that there were only minor problems affecting data usability. However, the data were not included in the LSP RI nor evaluated in this EE/CA, because the data were old, and conditions in Little Squalicum Creek may have changed significantly since the data were collected.

### 2.9.2 Site Hazard Assessment (Parametrix 1991)

Soil and groundwater samples were collected as part of the 1991 site hazard assessment performed for Ecology for the Oeser facility. SVOCs and total petroleum hydrocarbons (TPH) were analyzed in both media (Parametrix 1991). A data quality summary presented in the Oeser Site RI indicated that there were several problems that affected data usability, including exceeded holding times and method blank detection limits that were above sample detection limits. For these reasons, and because the data are old, they were not included in the LSP RI, nor evaluated for this EE/CA.

## 2.9.3 Wetland Mitigation Plan at Little Squalicum Creek (DEA 1993)

In 1993, David Evans and Associates (DEA), under contract with the Port of Bellingham, completed a Wetland Mitigation Plan at the LSC Site to evaluate possible mitigation of wetlands that could be impacted from the construction of a runway extension at the Bellingham International Airport (DEA 1993). As part of the study, DEA (1993) excavated a total of 36 test or hand soil pits within the boundaries of the LSC Site. Soil and groundwater observations were recorded (DEA 1993).

As part of the Wetland Mitigation Plan, DEA subcontracted Landau Associates, Inc. to perform a geotechnical evaluation to assist in wetlands and stream channel design. Subsurface conditions were evaluated by excavating 22 backhoe test pits and six hand explorations, with depths ranging from 1 to 6 feet bgs. Selected soil samples were analyzed for grain size and moisture content (DEA 1993).

The possible wetland mitigation measures evaluated as part of these studies were apparently not implemented.

## 2.9.4 Site Inspection Prioritization (URS 1994)

As part of the 1994 site inspection prioritization completed for the EPA, URS collected soil samples and analyzed the samples for SVOCs (URS 1994). Although a data quality summary presented in the Oeser Site RI indicated that there were no problems that affected data usability, the data are old and the depth of sediment collected was not indicated. For these reasons, the data were not included in the LSP RI nor evaluated for this EE/CA.

## 2.9.5 Expanded Site Inspection (E & E 1996)

As part of the expanded site inspection (ESI) conducted by the EPA for the Oeser Site in 1996, sediment and surface water samples were collected along Little Squalicum Creek. SVOCs and metals were analyzed in both media (E & E 1996). A data quality summary presented in the Oeser Site RI indicated that there were no problems that affected data usability. These data were included in the LSP RI and evaluated for this EE/CA. Although the samples are reported to have been



collected from the Little Squalicum Creek channel, the sample locations depicted in Figure 4 appear to lie outside of the position of the creek channel as mapped in the topographic survey. It is likely that the positions of either the samples and/or creek channel are in error. For the purposes of this EE/CA, it is assumed that the creek alignment is accurate and that the sample positions are in error.

### 2.9.6 Removal Assessment, Phase II (E & E 1998a,b)

In 1997, soil and surface water samples were collected from Little Squalicum Creek as part of the Phase II removal assessment performed for the EPA for the Oeser Site. Samples were analyzed for SVOCs and TPH (E & E 1998a,b) A data quality summary presented in the Oeser Site RI indicated that there were no problems that affected data usability. These data were included in the LSP RI and evaluated for this EE/CA.

### 2.9.7 Oeser Site RI/FS (E & E 2002a,b)

The EPA performed an RI/FS at the Oeser Site from 1998 to 2002 (E & E 2002a,b). The Oeser Site RI was a major source of data for this EE/CA. Types of samples collected in the vicinity of Little Squalicum Creek during the Oeser Site RI included subsurface soil (nine locations at B-AA2, B-AA4, B-AA6, B-BB3, B-BB5, and MWLSC01 through MWLSC04), surface soil (42 locations at B-AA2, B-AA4, B-AA6, B-BB3, B-BB5, SS-FS01 through SS-FS21, RES-43, RES-46, RES-47A, RES-48, RES-49, MWLSC01 through MWLSC04, and SP01 through SP07), sediment (11 locations at SD-1 through SD-11), groundwater (four locations at MWLSC01 through MWLSC03), seep (location SW-8), spring (location SW-3), surface water (seven locations at SW-1, SW-2, SW-4 through SW-7, and SW-09), and berries (three locations at Berry1 through Berry3; E & E 2002a). Soil and sediment sample locations are illustrated in Figure 4. Surface water, groundwater, and seep and spring water sample locations are illustrated in Figure 5. Most of the samples were analyzed for a full suite of analytes, including dioxins, extractable and volatile petroleum hydrocarbon fractions (EPH/VPH), TPH, volatile organic compounds (VOCs), SVOCs, metals, and conventionals. The data quality evaluation in the RI indicated that all precision, accuracy, representativeness, completeness, and comparability goals were achieved for the RI field and analytical investigation. Validated analytical precision and accuracy showed that more than 99% of all target compound and target analyte data were acceptable for use (E & E 2002a). These data were included in the LSP RI and evaluated for this EE/CA. Many additional data were obtained for samples collected at the Oeser facility. These data are not included in the LSP database.

## 2.9.8 Little Squalicum Creek Screening Level Assessment (Ecology 2004)

In 2003, Ecology evaluated six surface sediment samples (locations LSC01 through LSC06) collected from Little Squalicum Creek and two surface soil samples (LSCS1 and LSCS2) collected in the vicinity of Little Squalicum Creek. Sample locations are illustrated in Figure 4. All samples were analyzed for SVOCs using EPA Method 8270. The chemical data quality was acceptable, although some precision was lost in the analysis of SVOCs because of sample



dilutions required due to hydrocarbon interference. These data were included in the LSP RI and evaluated for this EE/CA.

### 2.9.9 Little Squalicum Park RI (Integral 2008)

The LSP RI was conducted by Integral for the COB from 2005 to 2008 under an Agreed Order between the COB and Ecology. Types of samples collected in the vicinity of Little Squalicum Creek during the LSP RI included subsurface soil (68 locations at HA-01 through HA-08, SB-01 through SB-42, and 18 of the TP locations depicted in Figure 4), surface soil (57 locations at HA-01 through HA-08, TP-01 through TP-31, and 18 of the SB locations depicted in Figure 4), subsurface sediment (13 of the SB locations depicted in Figure 4), subsurface sediment (11 of the SB locations depicted in Figure 4), groundwater (18 of the SB locations depicted in Figure 5), and surface water (locations SW-11 and SW-12, shown in Figure 5). Most of the samples were analyzed for PAHs, VOCs, SVOCs, petroleum, dioxins/furans, metals, and conventionals. A data quality summary presented in the LSP RI indicated that there were no problems that affected data usability (Integral 2008). The LSP RI was the main source of data used for evaluation in this EE/CA.

### 2.9.10 Estuary Feasibility Study (Coastal Geological Services)

In September 2009, for the COB, Coastal Geological Services installed 4 soil borings in the southwestern part of the Site in support of an estuary feasibility study. A slight to moderate diesel odor and slight sheen were observed at 2.5 feet bgs at the northernmost boring location, near the Marine Drive Bridge. Creosote odor was not observed in the sample (Herrenkohl 2009). No samples were collected for laboratory analysis. The apparent petroleum contamination may be attributable to a spill during sand and gravel mining operations or subsequent activities, such as log storage or operation of an asphalt batch plant that was located in the vicinity historically. The apparent petroleum contamination is not thought to be widespread because no obvious indications of petroleum contamination were observed in any of four test pits that were completed in this area during the LSP RI (Integral 2008 and Herrenkohl 2009).

3

# Source, Nature, and Extent of Contamination

## 3.1 Site Conceptual Exposure Model

This section summarizes the site conceptual exposure model (SCEM) for Oeser-related contaminants at the LSC Site. The SCEM describes the sources and nature and extent of contamination, and provides information about fate and transport and potential exposure pathways and receptors for the contaminants. Assessment of risk to human and ecological receptors at the LSC Site is discussed further in Section 4.

The SCEM is based on review and interpretation of physical and chemical data gathered during previous investigations at the LSC Site. As indicated in Section 2.9, analytical data from previous investigations were reviewed and assessed for usability as part of the Oeser Site RI and the LSP RI. Those data found to be usable were compiled into a master database and used for this EE/CA. Figure 4 depicts all of the sample locations for soil and sediment samples for which analytical data were available and appropriate for use in the EE/CA. Figure 5 depicts all of the sample locations for groundwater, surface water, and seep and spring water samples for which analytical data were available and appropriate for use in the EE/CA. These data are summarized in tables provided in Appendix A.

The SCEM for the LSC Site is depicted in Figure 6 and summarized below.

Contaminants of Potential Concern – Based on comparison of analytical results for samples collected at the LSC Site to conservative risk-based screening levels, the contaminants of potential concern (COPCs) at the LSC Site are PCP, PAHs, and dioxins/furans. Chemicals used and possibly released from the Oeser facility include PCP (which may contain dioxins/furans) mixed with a diesel carrier fluid, and creosote, both of which contain PAHs. However, dioxins/furans and PAHs also result from other anthropogenic processes besides wood-treating and are ubiquitous in the environment. Consequently, some of these chemicals detected in the LSC Site may be attributable to sources other than Oeser.

**Primary Sources** – Oeser-related sources of COPCs include creosote and PCP solutions used for wood treatment. During historical operations, these materials have been released to surface soil on the Oeser facility and/or to stormwater and/or process wastewater leaving the Oeser facility. Creosote and the diesel carrier fluid for PCP solutions are relatively insoluble, and at least some of the releases may have been in the form of a separate non-aqueous phase liquid (NAPL or "free product") that became entrained in the water. If present as a

#### 3. Source, Nature, and Extent of Contamination

mobile NAPL, creosote may tend to behave as a dense non-aqueous phase liquid (DNAPL, which are denser than water), although since its specific gravity is close to that of water, it may not exhibit typical characteristics of DNAPL. If present as mobile NAPL, diesel and other petroleum hydrocarbons would tend to behave as light non-aqueous phase liquids (LNAPL, which are less dense than water).

Non-Oeser sources for COPCs include vehicle emissions, urban runoff, chemical spills and dumping on other upstream properties, and spills and dumping within the LSC Site itself. Spills or dumping of petroleum hydrocarbons or other contaminants may have occurred during gravel mining operations or other activities within the LSC Site.

Release Mechanisms/Transport Mechanisms – COPCs released from the Oeser facility and other sources may have been transported to and within the LSC Site in a variety of ways, including wind/aerial deposition, stormwater runoff, process wastewater/spill discharges, infiltration/leaching to groundwater, and redistribution of contaminated soil and sediment. Based on the localized occurrence of sheen or NAPL and detection of COPCs in soil and sediment within and adjacent to both the present and historical channels of Little Squalicum Creek, and on the general absence or low concentrations of COPCs outside of these areas (except as noted below), the most likely release and transport mechanism for Oeser-related COPCs appears to be historical discharges of contaminated stormwater and process wastewater to Little Squalicum Creek via the Oeser/Birchwood storm drain. However, as noted above, non-Oeser sources of COPCs have likely contributed to releases within the Site.

Subsequent to discharges of Oeser-related COPCs into the creek, there may have been limited flow of contaminated stormwater/wastewater discharges into creek sediment and adjacent soils. Soil and sediment impacted by COPCs appear to have been subsequently redistributed. The presence of contaminated soils in the spoils piles and adjacent soils in the vicinity of the existing channel of Little Squalicum Creek is likely attributable to excavation and redistribution of contaminated sediment and adjacent soils along Little Squalicum Creek and/or other sources. The localized presence of COPCs and visible evidence of contamination (i.e., sheen or NAPL) in soils in the immediate vicinity of the existing channel of Little Squalicum Creek may be attributable to direct placement of contaminated soil/sediment (e.g., contaminated dredge spoils) during reworking of site soil/sediment during and/or after sand and gravel mining operations, possibly followed by migration of COPCs into underlying soil/sediment. The presence of COPCs and sheen or NAPL at some locations could also be the result of direct spills onto the ground prior to burial under the dredge spoils.

The presence of COPCs and sheen or NAPL in soils outside of the immediate vicinity of the historical and existing creek channel may be attributable to other sources (possibly including spills or dumping) and/or redistribution of previously contaminated soil/sediment as a result of extensive working of soils during historical sand and gravel mining operations or other activities. For example, the presence of COPCs and NAPL and sheen within the upper 2 to 3 feet reported at

#### 3. Source, Nature, and Extent of Contamination

test pit location TP06 appears to be the result of direct placement of contaminated fill at that location.

Farther from the alignment of both the historical and existing creek channel, COPCs and sheen or NAPL have been reported in subsurface soils at soil borings SB-25 and SB-31, which are located approximately 100 feet from the historical creek channel and 20 feet and 60 feet, respectively, from the existing creek channel. NAPL or sheen was reported at depths of between 4 and 6.6 feet bgs at location SB-25 and between 8 and 10 feet bgs at location SB-31. The presence of such COPCs and sheen or NAPL may be the result of placement of contaminated soil or spills or dumping during and/or after sand and gravel mining operations. The apparent absence of one or more probable clay layers at the anticipated elevations within soil borings SB-25 and SB-31 suggests that this area may have been excavated and subsequently backfilled. Such excavation and backfilling may have occurred during historical sand and gravel mining operations, which included establishment of temporary basins excavated to below the water table for gravel washing, and which were subsequently backfilled. Such backfill material may have included soils impacted by COPCs and exhibiting sheen or NAPL. The mode of occurrence of contamination within SB-25 ("light sheen" and "spotty sheen"), further suggests that contamination at this location may be due to direct placement of contaminated material rather than by lateral migration of mobile NAPL into the area. Within SB-31, chemical analytical results and visible (NAPL and sheen) and olfactory evidence of petroleum hydrocarbons is reported at depths between 8 and 10 feet bgs. The water table presently lies at approximately 3 feet bgs at location SB-31. Therefore, if the NAPL/sheen reported between 8 and 10 feet bgs consisted of mobile LNAPL, evidence of such impacts would also be expected to occur in the overlying intervals between approximately 3 and 8 feet bgs. However, the sample from 7 to 8 feet bgs did not exhibit sheen/NAPL and had no detections of petroleum hydrocarbons and very low concentrations of COPCs. These observations collectively suggest that the contamination observed at location SB-31 may be due to direct placement of contaminated material and/or spills prior to possible backfilling rather than lateral migration of mobile NAPL.

The discontinuous occurrence of NAPL or sheen across the site, in conjunction with the observation that where NAPL is reported it occurs primarily as isolated globules, and the likely mode of emplacement of contamination discussed above, suggests that little or no mobile NAPL exists at the site.

**Exposure Media/Secondary Sources** – The primary media impacted by releases of NAPL and COPCs are soil and sediment within and adjacent to the present and historical channels of Little Squalicum Creek. Several contaminated areas further from the channels may have been impacted by other sources and/or redistribution of contaminated creek sediment and soils. Partitioning and leaching/infiltration of the NAPL and COPCs may cause secondary media, such as surface water and groundwater, to become impacted by COPCs. However, existing groundwater data indicate that groundwater contamination by the COPCs appears to be limited to localized areas in close proximity to the creek channel or other areas exhibiting soil contamination (e.g., location SB-25); no continuous groundwater plume is



evident. Groundwater from monitoring well SB-32, located hydraulically downgradient (southwest) of the areas exhibiting soil and localized groundwater contamination, did not contain PCP or PAHs at levels above the detection limits.

Where groundwater is contaminated and in close proximity to Little Squalicum Creek along the gaining reach of the stream (see Section 2.6), it may migrate into surface water within the creek. However, existing data indicate that COPCs were either not detected or were detected at low concentrations in surface water samples collected at locations along the creek within and downgradient of the gaining reach, suggesting that significant migration of COPCs from contaminated soils and associated groundwater to surface water in Little Squalicum Creek is not occurring.

It should be noted that, as discussed in Section 2.6, much of the water within Little Squalicum Creek originates from stormwater runoff entering the creek through the Birchwood/Oeser storm drain, the Birchwood/BTC storm drain, and the Marine Drive storm drain outfalls (E & E 2002a). Stormwater from all of these sources are likely historical and ongoing sources of COPCs in the creek.

Exposure Routes/Receptors – Human users of the LSC Site may be exposed to COPCs in environmental media in a variety of ways, including inhalation, dermal contact, and ingestion. However, given the tendency of the contaminants to sorb to solids, contaminant distributions in Site media (limited mainly to solids in the present and historical creek channel and adjacent soils), and recreational use of the Site, dermal contact with contaminated sediment/soil and ingestion of contaminated sediment/soil by recreational users appear to be the primary routes for human exposure. Ecological receptors at the LSC Site may be similarly exposed, although bioaccumulation also plays a role in ecological exposure. More information about potential risks posed by LSC Site contaminants to human and ecological receptors is presented in Section 4 of this EE/CA.

## 3.2 Description of Contaminated Material

Based on the findings of previous investigations (E & E 2002a and Integral 2008), the primary COPCs to be addressed by the non–time-critical removal action at the LSC Site are PCP, PAHs (specifically, carcinogenic PAHs [cPAHs] and total PAHs [TPAHs]), and dioxins/furans. Soil and sediment have been identified as the principal media of concern; therefore, the removal action will address PCP, cPAHs, TPAHs, and dioxins/furans in soil and sediment. Consideration of cPAHs as a separate COPC is typical for human receptors because these compounds are the more toxic PAHs. Consideration of PAHs collectively as TPAHs is typical for ecological receptors, because PAHs occur in the environment in a variety of mixtures and act jointly under a common mode of action in affecting ecological receptors.

To define cleanup action areas and calculate contaminated material volumes for analysis in this EE/CA, proposed cleanup levels were identified for each COPC. The proposed cleanup levels were selected from a list of risk-based screening levels for human and ecological exposure, including those developed through the Oeser Site RI and LSP RI (Integral 2008) risk assessments and a 2007 risk

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evaluation (E & E 2007), and background levels. The 2007 risk evaluation is discussed in Section 4. The potentially applicable values and background concentrations are listed in Table 1. The background concentrations for cPAHs, TPAHs, and dioxins/furans are the 90<sup>th</sup> percentile values calculated from 22 background samples collected around Bellingham as part of the Oeser Site RI.

The analytical data for the surface and subsurface soil and sediment samples shown in Figure 4 were compared with the screening level and background values. The results were plotted on a series of maps (Figures 7 through 10) in order to better understand the distribution of the COPCs and to assess the concentrations of the COPCs in relation to the screening level values selected for the evaluation. For each map, sample concentrations were compared with multiple screening level and background values using color-coded map symbols and labels in order to evaluate the sensitivity of the distribution of the COPCs that exceeded various screening levels to the values of the screening levels. Differently colored symbols and labels on the maps indicate the concentration of the COPC at each sample location/depth relative to the screening levels selected for the evaluation. The areal patterns of screening level exceedances for each COPC were then examined and compared to identify which screening levels and COPC(s) would drive the removal action and to identify the portions of the LSC Site that would be targeted in the removal action.

Of all the COPCs, cPAHs appear to be distributed the most extensively, with exceedances of the lowest potentially applicable screening level (Washington State Model Toxics Control Act [MTCA] Method B value of 0.137 mg/kg) occurring throughout the LSC Site (see Figure 7). However, as noted previously, PAHs are ubiquitous in the environment. When the background concentration of cPAHs (0.37 mg/kg) is used for evaluation, the distribution of cPAH exceedances corresponds more closely to the locations of the present and historical channels of Little Squalicum Creek where PCP (Figure 8), TPAH (Figure 9), and dioxin/furan (Figure 10) screening level or background level exceedances also occur. A similar pattern is observed when a site-specific, risk-based cleanup level for cPAHs of 4.5 mg/kg (calculated for a recreational receptor with a target cancer risk of 1 x 10<sup>-6</sup>, discussed in Section 4) is used for screening.

Based on the overall coincidence of COPCs and the need for the removal action to be protective of both human and ecological receptors, the following cleanup levels are proposed for the removal action:

- **PCP** 0.69 mg/kg (Washington State CSL for Marine Sediment)
- **cPAHs** 4.5 mg/kg (site-specific risk-based screening level for a recreational receptor, 1 x 10<sup>-6</sup> target cancer risk)
- **TPAHs** 3.6 mg/kg (background soil concentration)
- **Dioxins/furans** 1.2 x 10<sup>-5</sup> mg/kg (background soil concentration)

It should be noted that, as with cPAHs, site-specific, risk-based screening levels were also calculated for humans (calculated for a recreational receptor with a



target cancer risk of 1 x 10<sup>-6</sup>, discussed in Section 4) for dioxins/furans and PCP. The site-specific human health cleanup levels for PCP and dioxins/furans are 224 mg/kg and 2.7 x 10<sup>-4</sup> mg/kg, respectively. Each of these human health cleanup levels is well above the proposed cleanup levels. Thus, cleanup to the proposed cleanup levels will be protective of human health.

### 3.3 Location of Contaminated Material

As indicated above, soil and sediment impacted by COPCs lies primarily within the existing and historical channels of Little Squalicum Creek and some areas adjacent to those channels. For the purposes of this EE/CA, these areas are referred to as the Existing Creek Channel Removal Action Area and the Historical Channel Removal Action Area. The approximate areas and depths targeted for the removal action are illustrated in Figures 7 through 10. These areas are based on the SCEM for releases and transport of COPCs at the Site and on sample results indicating exceedances of one or more screening levels for one or more COPCs in soil and sediment.

Because of uncertainties about the areas and volumes of material that may be subject to such action, the boundaries of the removal action areas depicted in Figures 7 through 10 are approximate. For example, for simplicity, the boundaries of the Existing Creek Removal Action Area were defined for the purpose of this EE/CA as encompassing the area within a fixed distance from the existing creek channel. For the purposes of this EE/CA, the extent of the historical creek channel is based on information provided in the LSP RI. The Historical Channel Removal Action Area is defined for the purposes of this EE/CA to extend approximately 5 feet beyond the "Extent of Historical Creek" on each side along Alignment B (see Appendix B, Figure B1).

COPCs do not occur throughout the entire removal action areas depicted in Figures 7 through 10 at concentrations exceeding the proposed cleanup levels.

The approximate removal action areas and depths depicted in Figures 7 through 10 were used for development of approximate cleanup areas and volumes for analysis in this EE/CA. It is anticipated that the removal action areas/depths/volumes may be refined during development of an engineering design (to be developed after completion of this EE/CA) and/or during characterization activities conducted during the removal action. Several locations with soil/sediment sample concentrations exceeding proposed cleanup levels lie outside of the approximate boundaries of the removal action area depicted in Figures 7 through 10; these locations are discussed below.

Sample locations LSC-02, LSC-03, OS02, OS05, and SP02 lie outside of the approximate removal action area depicted in Figures 7 through 10, apparently because of incorrect location information. The subject samples are stream sediment samples collected from the existing Little Squalicum Creek channel; however, the sample locations appear to lie outside of the area of the creek channel as depicted in the topographic survey. It is likely that the positions of either the samples and/or creek channel are in error. For the purposes of this

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EE/CA, it is assumed that the sample positions are in error, and the removal action area is based on the surveyed position of the existing creek channel.

Sample locations SB-18 and SB-20 appear to be located slightly outside of the approximate removal action area boundary depicted in Figures 7 through 10. The areas encompassing these locations may be subject to removal action. Because there are uncertainties about the areas and volumes of material that may be subject to such action, these areas are not included in the approximate cleanup action areas and associated volume calculations at this time. These areas are expected to be further evaluated during development of an engineering design for the cleanup action.

The area of sample location LSC-05 is excluded from the removal action area because, although PCP was detected in the sample, its concentration was only slightly above the proposed PCP cleanup level and its presence at that location is not consistent with the SCEM for distribution of COPCs at the Site.

Several COPCs were detected in a surface sediment sample at location OS06, located within the stormwater drainage channel between the Birchwood/Oeser stormwater outfall and the concrete box culvert. The area of this stormwater drainage channel may be subject to possible removal action. The extent to which this area will be addressed will be evaluated during design and implementation of the removal action.

One or more COPCs were detected in soil samples above one or more screening levels from locations SB-09, SB-12, and SB-14, which lie slightly outside of the approximate removal action area boundary depicted in Figures 7 through 10. The areas encompassing these locations may be subject to removal action. As stated above, because of uncertainties about the areas and volumes of material that may be subject to such action, the boundaries of the removal action areas depicted in Figures 7 through 10 are considered approximate. The areas including locations SB-09, SB-12, and SB-14 are not included in the approximate cleanup action areas and associated volume calculations in this EE/CA. These areas are expected to be further evaluated during development of an engineering design for the cleanup action.

Although laboratory analytical results for soil samples from some depth intervals at soil boring locations SB-25 and SB-31 are not available, visual and/or olfactory observations of soil collected from these borings suggest that COPCs may be present within the upper 6 feet at these locations. Specifically, "light sheen" was reported in soil collected from 4 to 5 feet bgs in soil boring SB-25, and "moderate petroleum odor" and "slight petroleum odor" were reported for soil collected from approximately 3 to 4.5 feet bgs in SB-31. Soil borings SB-25 and SB-31 lie outside of the approximate removal action area boundaries depicted in Figures 7 through 10. The areas encompassing these locations may be subject to removal action. Because there are uncertainties about the areas and volumes of material that may be subject to such action, these areas are not included in the approximate cleanup action areas and associated volume calculations at this time. These areas



are expected to be further evaluated during development of an engineering design for the cleanup action.

TPAHs and cPAHs were present at concentrations exceeding the proposed cleanup levels in subsurface soil samples from SB-42 and SB-22. However, the samples with exceedances are from depths greater than 6 feet (i.e., deeper than the maximum depth for possible exposure of ecological receptors, as discussed in Section 4). Therefore, these areas are not considered to pose a current risk. Contaminated soil at these locations will be addressed as discussed in Section 7.

The cPAH concentration at location RES-46 was calculated using non-detect reporting limits. Therefore, location RES-46 was not included in the removal action area because the results of the analysis of the samples did not reflect actual detections of cPAHs.

For dioxins/furans, there are several samples from locations that lie outside of the general areas of the existing and historical creek channels (RES-43, B-AA4, B-BB5, MWLSC01, MWLSC02, MWLSC03, and MWLSC04) with concentrations greater than the Bellingham area background concentration. However, dioxins/furans at these locations are not co-located with PCP, which would be the primary source of Oeser-related dioxins/furans within the LSC Site. Furthermore, the calculated toxic equivalency (TEQ) concentrations at B-AA4 and B-BB5 are based on non-detect reporting limit values. There were no detections of dioxins/furans at these locations.

### 3.4 Volume of Contaminated Material

Following the selection of proposed cleanup levels and the definition of the removal action areas, contaminated material volumes were calculated for analysis in this EE/CA. Volumes were calculated using sample results and the application of proposed cleanup levels, as follows.

Excavation lines were drawn in AutoCAD Civil 3D to mark the transition between the different depths of excavation required. The Existing Creek Channel Removal Action Area was divided into two alignments (see Appendix B, Figure B-1). Alignment A consists of the actual stream channel as determined from the 2008 topographic survey, and Alignment A2 is the approximate center line of the channel immediately downstream of the Oeser/Birchwood outfall. This portion of the channel was not surveyed in detail during the 2008 topographic survey because of the steep slope. The excavation along Alignment A was assumed to extend 5 feet beyond the surveyed creek extent on each side. The excavation along Alignment A2 was assumed to extend 8 feet beyond the alignment on each side, resulting in a consistent width of excavation along the two alignments. A single alignment, Alignment B, was used for the Historical Creek Channel Removal Action Area. This excavation was assumed to extend 5 feet on each side beyond the historical creek area.

The sample results for each sample location within the excavation areas were evaluated to identify the depth of proposed cleanup level exceedances and



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determine the appropriate depth of excavation. The maximum depth of excavation is set at 6 feet because, as discussed in Section 4, that is the maximum depth of potential ecological exposure. The maximum depth of soil/sediment exposure for humans is less.

Cross sections and excavation lines were subsequently applied along the alignments using the Average-End-Area Method to calculate the contaminated material volumes.

The volume of contaminated material associated with the Existing Creek Channel Removal Action Area was calculated to be approximately 3,130 cubic yards (CY) and the volume of contaminated material associated with the Historical Creek Channel Removal Action Area was calculated to be approximately 6,980 CY. The volume calculations are presented in Appendix B. As noted above, the removal action areas/depths used for the calculation of volumes in this EE/CA are approximate.

### 3.5 Physical and Chemical Attributes of COPCs

#### 3.5.1 PCP

The source of PCP at the LSC Site is thought be from historical releases of the chemicals from the Oeser facility. In surface waters, PCP undergoes biotransformation and photolysis, and is adsorbed to sediments. In soils and sediments, PCP is metabolized by microorganisms or is adsorbed. Adsorption decreases in neutral and basic soils and is strongest in acidic soils. The compound has been found to bioaccumulate to modest levels, but food chain biomagnification has not been observed. Humans are generally exposed to PCP through air, food, soil, and drinking water, as well as contact with preservative-treated wood products. The levels and lengths of exposure are not well understood, but it is known that even long-term, low-level PCP exposure causes harmful effects on the liver, kidneys, blood, lungs, and organ systems; these effects are magnified with increased duration and concentration. Additionally, EPA has classified PCP as a probable human carcinogen (ATSDR 2001).

### 3.5.2 PAHs

The source of much of the PAHs at the LSC Site is thought to be from historical releases of creosote and PCP diesel carrier fluids from the Oeser facility. However, PAHs are ubiquitous in the environment due to many natural and anthropogenic sources. Most PAHs enter the aquatic environment from atmospheric deposition, industrial effluent, municipal waste water, and urban runoff and are sorbed to sediments. It is estimated that only one-third of PAHs in aquatic systems are found in dissolved form (ATSDR 1995a). Most PAHs are transformed in water by photooxidation, chemical oxidation, and microbial metabolism, or are transported from surface waters by volatilization and sorption to settling particles. In sediments, microbial metabolism is the major process for degradation of PAHs. Additionally, PAHs are bioaccumulated in terrestrial and aquatic plants, fish, and invertebrates; however, many animals are able to metabolize and eliminate these compounds. Humans are exposed to PAHs mainly through inhalation of tobacco smoke, wood smoke, and ambient air.



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Additionally, many common household foods are contaminated with PAHs. EPA has classified several PAH compounds as probable human carcinogens. Laboratory studies show long-term exposure to PAH mixtures results in tumor development, as well as adverse affects on the skin, bodily fluids, and immune and reproductive systems (ATSDR 1995a).

### 3.5.3 Dioxins/Furans

Dioxins are present as impurities in technical-grade PCP, which was released from the Oeser facility. Dioxins also enter aquatic systems from paper-making, the production and disposal of herbicides and other chemicals, and other sources. Some dioxins that enter water are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water (ASTDR 1999). Dioxins in the aquatic environment are highly lipophilic and bioaccumulate in plants, fish, and invertebrates. Dioxins have low water solubility and low chemical reactivity, making them unlikely to dissolve in the water column and resistant to biodegradation. In turbid environments, resuspension of these compounds is common and leads to increased uptake by aquatic life. Because they degrade very slowly by chemical or biological processes, dioxins are persistent environmental contaminants (ATSDR 1995b). Approximately 90% of general human exposure is through food; however, dioxins present in contaminated soil or materials are absorbed through dermal contact. The most common health effects related to dioxin exposure are chloracne and other skin problems, though changes in blood and urine that may indicate liver damage have also been reported. EPA has determined that certain mixtures of dioxins and other compounds are probable human carcinogens (ATSDR 1998).

Like dioxins, furans are present as impurities in PCP, which was released from the Oeser facility. Furans also enter the environment through combustion processes including residential, municipal, and industrial incineration; improper disposal of paper-making wastes; and improperly managed waste streams. In aquatic systems, these compounds are mostly present in the particulate-sorbed phase. Furans in the aquatic environment are lipophilic and bioaccumulate in plants, fish, and invertebrates. These compounds are highly insoluble and have low chemical reactivity; it is unlikely that significant loss of furans in water or sediment would occur by chemical or biodegradation processes. As for dioxins, a large majority of human exposure to furans is through eating contaminated foods. However, minor exposure routes are ambient air, certain materials, and workplace hazards. Skin and eye irritations are the most common effect from acute furan exposure, although vomiting, diarrhea, anemia, lung infections, and other effects are known to occur. It is not understood how long-term, low-level furan exposure affects humans (ATSDR 1994).

### Streamlined Risk Evaluation

A baseline human health risk assessment (HHRA) and ecological risk assessment (ERA) were conducted for the Oeser Site as part of the Oeser Site RI (E & E 2002a, Appendices M and N). These risk assessments included the area of the LSC Site. Based on these assessments, the EPA determined that cleanup action at the LSC Site was not warranted. Subsequent investigations at the LSC Site by Ecology (Ecology 2004) and the COB (Integral 2008) identified additional areas of contamination in the LSC Site not found during the Oeser Site RI. This section summarizes updated human health and ecological risk evaluations for the LSC Site (E & E 2007) using previously existing data from the Oeser Site RI and the newly generated data obtained by Ecology (Ecology 2004) and Integral (the 2008 LSP RI). The updated risk evaluations were conducted to determine whether levels of Oeser Site—related COPCs at the LSC Site are great enough to be considered actionable under CERCLA and to identify possible cleanup levels. The risk evaluations conducted by other parties are referred to, as appropriate.

### 4.1 Human Health Risk Evaluation

Appendix C includes a human health risk evaluation conducted by E & E in 2007 (E & E 2007). The 2007 risk evaluation was performed to assess whether data collected at the LSC Site subsequent to the Oeser Site RI indicated levels of contamination at the LSC Site that could pose risk to human health that may be considered actionable under CERCLA. The evaluation was based on the SCEM for a human recreational receptor depicted in Figure 6. This SCEM is consistent with that used for the assessment of risk to recreational receptors at the LSC Site used in the Oeser Site RI HHRA. The risk evaluation was focused on dermal. ingestion, and inhalation pathways for an adolescent recreational user, the user expected to spend the greatest amount of time at LSP and come into contact with contaminated media at the greatest frequency. For the 2007 human health risk evaluation, it was conservatively assumed that, for subsurface soil up to a maximum depth of 15 feet bgs, ingestion, dermal contact, and inhalation of vapors and particulates are potentially complete pathways for current and future recreational users. It should be noted that risk of exposure to subsurface soils by recreational users of the site is limited to soils at much shallower depths. The COPCs addressed in the evaluation are PCP, cPAHs, and dioxins/furans, the contaminants associated with releases from the Oeser facility.

To assess exposure to COPCs in soils, sediment, and surface water, the exposure parameters and intake equations presented in Tables 4.11 through 4.15 of the



2002 Oeser Site RI HHRA (E & E 2002a) were used. The only exception was evaluation of dermal exposure to contaminants in surface water. For dermal exposure to surface water, E & E used the exposure parameters presented in Table 4.14 of the 2002 Oeser Site RI HHRA (E & E 2002a), but the intake equations provided in the document Risk Assessment Guidelines for Superfund (RAGS), Part E (EPA 2004) were used because the process for evaluating dermal exposure to contaminants in surface water has been updated since the 2002 Oeser Site RI HHRA was completed. To calculate the intake (or dermal absorbed dose) for dermal exposure to contaminants in surface water, it was assumed that the event frequency (number of times exposure occurred during a day) was one event per day and the event duration was 1 hour per event. This assumes a recreational visitor is in contact with surface water for 1 hour a day during each visit to the Site. These values are conservative estimates of recreational exposure at the Site. and consistent with other exposure parameters used in the 2002 Oeser Site RI HHRA (E & E 2002a). Maximum detected Site concentrations in each media were used as the exposure point concentration (EPC).

For the 2007 evaluation, E & E updated all toxicity criteria, cancer slope factors (SF) and non-cancer reference doses (RfDs), to ensure that the most recent values were used in this evaluation. Oral RfDs and SFs were used for both oral and dermal routes of exposure. Oral toxicity values were not adjusted for dermal exposure to the Site COPCs, which is consistent with RAGS Part E (EPA 2004). All oral toxicity values were obtained from the EPA's Integrated Risk Information System (IRIS), except for cPAHs and dioxins/furans. For cPAHs, an inhalation RfD from IRIS was available only for naphthalene. Therefore, E & E obtained available inhalation toxicity criteria from other sources, consistent with the EPA's recommended hierarchy (2003). An inhalation SF was obtained for PCP (SF = 0.018 [mg/kg]/day) from the California EPA (2002). No other inhalation toxicity criteria were available.

The toxicity of cPAHs as a class of compounds was assessed. Various non-bioassay results have been used to determine relative potency factors (RPFs) for the constituent cPAH compounds. Therefore, the aggregate concentration of cPAHs was calculated by multiplying the concentration of each individual cPAH constituent by its respective RPF and summing the results for all cPAHs. Following the EPA's document *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons* (EPA 1993), E & E calculated the cPAH concentrations using all 25 cPAH compounds using the EPA RPF values. As a conservative measure, a value of one-half the detection limit was used as the concentration for each of the "non-detect" results. The SFs for benzo(a)pyrene were used to evaluate the toxicity of cPAHs. The oral SF is available from IRIS and the inhalation SF is available from the National Center of Environmental Assessment (EPA 2007).

Individual dioxins and furans are evaluated based on how their toxicity is related to the similar toxic effect of 2,3,7,8- tetrachlorodibenzo-p-dioxin. The relationship between the toxic effects is expressed in terms of a factor, known as the toxicity equivalency factor (TEF). The 2005 World Health Organization



(WHO) TEFs (Vanden Berg et al. 2005) were used in this assessment. The assessment of human health risks resulting from exposure to dioxins relies not on data for the individual dioxins and furans, but rather on a value derived using compound-specific concentrations and TEFs. The result is a toxicity value expressed in terms of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) TEQ. The TEQ is calculated by multiplying the measured concentration of each dioxin/furan compound by its assigned TEF and summing all the product values. As a conservative measure, a value of one-half the detection limit was used as the concentration for each of the non-detect results. The oral SF for 2,3,7,8-TCDD was used to assess the toxicity of the total TEQ. No oral SF is available from IRIS for 2,3,7,8-TCDD; therefore, a value from Health Effects Assessment Summary Tables (HEAST; EPA 1997b) was used in this assessment. This is consistent with the toxicity hierarchy approach specified by the EPA (2003).

The risk evaluation found that when exposure to maximum concentrations at the Site as a whole was evaluated, the potential risk to the adolescent recreational user exceeded the EPA cancer threshold of 1 in 10,000 (10<sup>-4</sup>). The non-cancer hazards were below the EPA benchmark of 1. To evaluate human health risk further, the 95% upper confidence limit (UCL) on the mean was calculated for subsurface soil using the EPA's ProUCL Version 3.0 software. For subsurface soil, as a conservative measure, samples from depths up to 15 feet bgs were included in the 95% UCL calculation. This is the depth to which subsurface soil could be brought to the surface during excavation activities. As noted above, the risk of exposure to subsurface soils by recreational users of the site is limited to soils at much shallower depths. The 95% UCL was calculated for the Site as a whole based on the conservative assumption that exposure to human receptors would be distributed throughout the Site. The resulting 95% UCL for cPAHs in subsurface soil for the Site is 51.53 mg/kg; the maximum Site concentration is 509.66 mg/kg. The resulting cancer risk for exposure to subsurface soil, using the 95% UCL as the EPC for cPAHs in subsurface soil is 1.3 x 10<sup>-5</sup>.

### 4.2 Ecological Risk Evaluation

Appendix C includes an ecological risk evaluation conducted by E & E in 2007 (E & E 2007). The 2007 risk evaluation was performed to assess whether data collected at the LSC Site subsequent to the Oeser Site RI indicated levels of contamination at the LSC Site that could pose risk to ecological receptors that may be considered actionable under CERCLA. The evaluation was based on the SCEM for ecological receptors depicted in Figure 6. This SCEM is consistent with that used for the assessment of ecological risk at the LSC Site used in the Oeser Site RI ERA. The ecological receptors evaluated were vegetation, soil invertebrates, benthic invertebrates, and insectivorous wildlife.

As for the Oeser Site ERA, the COPCs evaluated in the 2007 evaluation were PCP, PAHs, and dioxins/furans. PAHs were evaluated collectively as TPAH because PAHs exert their toxicity primarily in an additive manner. Dioxins/furans were evaluated collectively as the 2,3,7,8-TCDD TEQ concentration. Soil contamination at the Site has the potential to adversely affect three assessment endpoints: (1) plants, (2) soil invertebrates, and (3) wildlife.



Potential risks to these assessment endpoints were reassessed using surface and subsurface soil samples from up to 6 feet bgs. Samples from up to 6 feet bgs were used because plants, soil invertebrates, and/or burrowing mammals may be reasonably expected to contact soil contamination down to this depth. Soil and sediment were considered together as one exposure medium because the LSC Site includes seasonally flooded wetland habitat, so the boundary between soil and sediment is indistinct in some parts of the LSC Site. Furthermore, the COB has indicated that additional freshwater or brackish wetlands may be created within the LSC Site and the channel of Little Squalicum Creek may be realigned as part of its planned park development. Consequently, conversion of terrestrial to wetland/aquatic habitat and vice-versa within the Site is likely.

The evaluation used the same screening benchmarks, exposure parameters, and calculation methods as were used in the Oeser Site ERA, so the updated results would be comparable.

The evaluation concluded that levels of soil and sediment contamination at the LSC Site are great enough to pose a risk to plants, soil invertebrates, insectivorous wildlife, and benthos, and that TPAHs and dioxins/furans are the principal chemicals of concern. Potential risks from PCP in soil and sediment were found to be much lower than those due to PAHs and dioxins/furans for all receptors evaluated (plants, soil invertebrates, insectivorous wildlife, and benthos).

For TPAHs, the exposure estimates and hazard quotients for the robin and shrew were greater in the 2007 evaluation than those calculated for the 2002 Oeser Site ERA by a factor of five. For the robin, the hazard quotient based on the lowest observed adverse effects level (LOAEL) was still less than 1, in spite of being five times greater than the hazard quotient in the ERA. However, for the shrew, the LOAEL-based hazard quotient increased from 3.4 (Oeser Site ERA) to 15.8 in the 2007 evaluation. This suggests that insectivorous mammals in the ravine may be affected by PAH contamination in soil. Although the LOAEL-based hazard quotient for the shrew for TPAHs also was greater than 1 in the 2002 Oeser Site ERA, it was argued in the ERA that an adverse impact to the local shrew population was unlikely for several reasons: (1) only one area of PAH soil contamination was identified at that time; (2) the TPAH concentration in earthworms, the assumed prey of the shrew, was conservatively modeled, not measured; and (3) besides earthworms, shrews consume other foods (e.g., grasshoppers) that are less likely to accumulate PAHs from soil. This argument is no longer supportable given that a more extensive area of PAH contamination in soil has been identified within the LSC Site and the newly calculated LOAELbased hazard quotient for the shrew for TPAHs is 15.8.

For dioxins/furans, the exposure estimates and hazard quotients for the robin and shrew in the 2007 evaluation were greater than those calculated for the 2002 Oeser Site ERA by a factor of two. For the robin, the LOAEL-based hazard quotient was 1, suggesting that a threshold for adverse effects had been reached. For the shrew, the newly calculated LOAEL-based hazard quotient was 14.4, suggesting that insectivorous mammals in the ravine might be affected by



dioxin/furan contamination in soil. As noted above for TPAHs, the LOAEL-based hazard quotient for the shrew for dioxins/furans also exceeded 1 in the 2002 Oeser Site ERA. However, for the same reasons stated above for TPAHs, a population-level risk from dioxins/furans was considered unlikely in the 2002 ERA. This position is no longer supportable given that additional areas of dioxin/furan contamination have been identified and the newly calculated LOAEL-based hazard quotient for dioxins/furans is 14.4.

### 4.3 Removal Action Criteria

Subsequent to the 2007 human health risk evaluation, E & E compiled risk-based and background concentrations for PCP, PAHs, and dioxins/furans for environmental media in LSP to identify possible cleanup levels for protection of human health at the Site. These values were presented to and reviewed by representatives from Ecology, COB, and Oeser, and revised based on comments from these parties. The final list is provided in Table 1. Of these values, it was concluded that, for human health risk, cleanup levels for soil based on an adolescent recreational user scenario were most appropriate to use for soil and sediment at the LSC Site. These values and the methods and input parameters used to calculate them are provided in Table 2.

Subsequent to E & E's 2007 ecological risk evaluation, E & E compiled risk-based screening levels and background concentrations for PCP, PAHs, and dioxins/furans for environmental media to identify possible cleanup levels for protection of ecological receptors at the Site. These values were presented to and reviewed by representatives of Ecology, COB, and Oeser and revised based on comments from these parties. The final list is provided in Table 1. From this list, conservative cleanup levels for soil/sediment for PCP, TPAHs, and dioxins/furans were identified. Table 3 presents the proposed cleanup levels for soil/sediment for protection of ecological receptors, and the rationale for proposing them.

Removal action criteria should be protective of both human and ecological receptors. Based on this, the lower of the proposed human health and ecological cleanup levels, respectively, presented in Tables 1 and 2 are proposed as removal action criteria for soil and sediment in LSP. These values were used to identify soil or sediment to be cleaned up as part of a non-time critical removal action.

Contaminated soil/sediment deeper than 6 feet is not proposed to be removed because it does not currently pose an unacceptable risk to ecological receptors. As stated in Section 4.1, applying conservative assumptions for evaluation of current risk to human receptors for exposure to subsurface soil – specifically calculating the 95 % UCL for the site as a whole and using all soil samples from depths from 0 to 15 feet bgs to calculate the 95% UCL calculation – the cancer risk for exposure to subsurface soil currently is 1.3 x 10<sup>-5</sup>. Following a removal action that includes excavation of contaminated soil/sediment from 0 to 6 feet bgs, the site-wide risk would be significantly lower than 1.3 x 10<sup>-5</sup>.



# **Applicable or Relevant and Appropriate Requirements**

The EPA has identified potential applicable or relevant and appropriate requirements (ARARs) for this CERCLA removal action. The EPA's document *Guidance on Consideration of ARARs during Removal Actions* provides the definitions given below.

Applicable requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances found at a CERCLA site.

Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well-suited to the particular site.

Other information To Be Considered (TBC) generally falls within three categories: health effects information with a degree of credibility, technical information on how to perform or evaluate site investigations or response actions, and policy. (EPA 1991)

Table 4 identifies the major federal and state requirements that may be associated with a removal action at the LSC Site, including potential action-specific ARARs that may apply to the selected removal action alternative. Final ARARs are selected in the decision document, which is called an Action Memorandum.



## **Identification of Removal Action Objectives**

Removal action objectives (RAOs) have been developed for the LSC Site based on an analysis of the sources of contamination, the nature and extent of contamination, and the results of the human health and ecological risk assessments. The RAOs have been developed to control the contamination sources and mitigate the potential for exposure of humans and ecological receptors to contamination at the LSC Site. The RAOs must be achieved while attaining the ARARs (identified in Section 5) to the extent practicable.

### The RAOs are to:

- Prevent or reduce human exposure (through inhalation, ingestion, and dermal contact) to PCP, cPAHs, and dioxins/furans above cleanup levels in soil/sediment at the LSC Site;
- Prevent or reduce ecological receptor exposure (through inhalation, ingestion, and dermal contact) to PCP, TPAHs, and dioxins/furans above cleanup levels in soil/sediment at the LSC Site;
- Prevent or reduce potential migration of PCP, cPAHs, TPAHs, and dioxins/furans above cleanup levels in soil/sediment at the LSC Site via surface runoff, erosion, and wind dispersion; and
- Prevent or reduce potential migration of PCP, cPAHs, TPAHs, and dioxins/furans above cleanup levels in soil/sediment at the LSC Site to groundwater and eventual potential recharge to surface water.

### 6.1 Removal Schedule

The removal action could commence within 6 months following approval of this EE/CA.



# Identification and Analysis of Management and Treatment Technologies and Removal Action Alternatives

According to 40 CFR 300.415, the purpose of an EE/CA is to analyze potential removal action alternatives based on current site conditions to address contamination present at a site. The alternatives are evaluated and developed employing the criteria specified in the EPA document *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993). Specifically, each removal action alternative has been developed and analyzed against the RAOs and evaluation criteria separately.

The development and analysis of removal action alternatives involves the following four steps:

- 1. Identification of broad categories of potential removal actions;
- 2. Identification and screening of the broad array of technologies that may apply to each category;
- 3. Assembly of identified removal action categories and technologies into removal action alternatives; and
- 4. Analysis of removal action alternatives against the evaluation criteria.

In Section 7.2, the general categories of potential removal actions are identified and described. The broad array of technologies that may apply to each category are identified and screened in Section 7.3. This preliminary screening procedure has been conducted to identify those technologies applicable to the Site that may be effective in meeting the RAOs. In Section 7.4, the potential removal actions and technologies retained from the screening process in Section 7.3 are assembled into removal action alternatives. Finally, an analysis of the alternatives using the criteria of effectiveness, implementability, and cost is presented in Section 8.

As noted in Section 2.1, COB recently completed and adopted a plan for LSP titled *Little Squalicum Park Final Master Plan* (COB 2010). The new plan calls for enhancement of park activities, site restoration, and resource protection. The plan envisions incorporation and enhancement of features created as part of environmental cleanup, including the planned LSC Site removal action, into the park ecologic framework. Such features include land forms and hydrologic



features such as Little Squalicum Creek and wetlands. Implementation of the elements in the plan is contingent on funding. To the extent practicable and consistent with the NCP, EPA considered the City's park plan in its evaluation of the removal action alternatives for the LSC Site.

### 7.1 Overview of Evaluation Criteria

The three general criteria for evaluation of alternatives are effectiveness, implementability, and cost. The specific components of each criterion are defined below.

### **Effectiveness**

- Overall protectiveness of human health and the environment
- Ability to achieve RAOs/ARARs
- Short- and long-term effectiveness

### **Implementability**

- Technical feasibility
- Administrative feasibility
- Availability of materials and sources
- Community acceptance

#### Cost

- Capital cost
- Post-Removal Site Control (PRSC) cost

### 7.2 Description of Broad Categories of Potential Removal Actions

The broad categories of potential removal actions for this Site are:

- No action
- Institutional controls
- Surface water controls
- Management and/or treatment of contaminated material

#### 7.2.1 No Action

The No Action Alternative leaves contaminated material at the Site in its current condition and assumes no further intervention will occur. Although the No Action Alternative would not actively meet the RAOs for the Site, its consideration and evaluation is required. Other potential response actions will be



compared with the baseline provided by the No Action Alternative. Under the No Action Alternative, no response activities or monitoring would occur at the Site.

#### 7.2.2 Institutional Controls

Institutional controls are non-engineered controls, such as administrative and legal restrictions, that help minimize the potential for human and ecological receptor exposure to contamination and protect the integrity of the remedy. In other words, administrative and legal controls do not actively address site contamination, but attempt to meet the RAOs by reducing the potential for exposure to the contaminated material. These controls do not address the mobility of the contamination or the offsite transport of contaminated material via other exposure pathways. Used in conjunction with an active technology, institutional controls can be an effective deterrent to deterioration of a remedy component such as an engineered cap by providing controls that address natural processes such as erosion and for human intrusion such as trespassing or vandalism. Institutional controls are generally combined with other removal actions.

#### 7.2.3 Surface Water Controls

Surface water run-on controls or stormwater management structures include drainage channels, ditches, trenches, or other structures engineered to prevent surface water from coming into contact with contaminated material. By preventing contact, erosion of contaminated surfaces and subsequent offsite transport of contaminants via the surface water pathway are reduced. However, these controls do not address direct exposure of contaminants to human or ecological targets, or the offsite transport via other exposure pathways, particularly the air pathway. Surface water controls may be used in conjunction with other removal actions to help the other removal actions perform optimally.

### 7.2.4 Management and/or Treatment of Contaminated Material

Management or treatment of contaminated material includes options that can be conducted *in situ* or *ex situ*. *In situ* treatment methods for the Site would require a moderate level of handling of the contaminated material. Stabilization of the contamination in place, restricting potential exposure by capping, or using innovative technologies to remove the contaminants without physically removing the contaminated material have been identified and potential options are presented in Section 7.3. In addition, treatment methods involving removal of the material to onsite or offsite locations have been reviewed and are also presented in Section 7.3. In general, options that involve excavation of contaminated material would often meet the RAOs by removing the contaminants from the property; however, a higher initial cost is associated with these actions. Removal actions that involve leaving material in place are likely less expensive in the short term but tend to involve long-term operation and maintenance.

Site stabilization measures typically follow removal in order to remove temporary construction features and bring natural processes such as erosion and deposition back into equilibrium. Site stabilization includes measures for amending and



improving the soil to support vegetation, and revegetating the site to stabilize the soil and support wildlife.

### 7.3 Identification and Screening of Management and Treatment Technologies

#### 7.3.1 No Action

The No Action Alternative does not require the use of any management or treatment technologies.

*Site-Specific Evaluation:* Although the No Action Alternative would not meet the RAOs, it is used as a baseline against which other alternatives are measured. For this reason, it is retained for further evaluation.

#### 7.3.2 Institutional Controls

Institutional controls are used to restrict access to or control use of a site. They may include land use restrictions, warning signs, and site patrols, depending on the site.

Site-Specific Evaluation: Institutional controls by themselves, although retained for further analysis as a component of other identified alternatives in Section 7.4, are not expected to sufficiently address the RAOs. Institutional controls appropriate for the LSC Site may include land use restrictions, warning signs, public education, and site patrols. Land use restrictions would be effective in limiting contact with contamination left in place. Warning signs and site patrols might be effective in limiting unwanted access. Institutional controls, if not used in conjunction with an active technology, would not address the potential for offsite migration of the contamination. However, if combined with an active technology, institutional controls can be effective in the protection of a cap, prohibiting the excavation of contaminated soil or prescribing the management of soils excavated.

### 7.3.3 Surface Water Controls

Surface water control measures are implemented to reduce contaminant mobility by limiting water erosion processes. Drainage channel modifications are used for many purposes, including relocation or diversion of a stream around potentially contaminated areas. One approach is to use surface water management systems that divert stormwater away from contaminated areas, and possibly use vegetation or armoring to limit the potential for erosion. This option can be effective in reducing the potential for migration of contaminants; however, it would not reduce the potential for direct human and/or ecological exposure. Surface water controls would be essential during construction of removal measures.

*Site-Specific Evaluation:* Surface water controls by themselves, although retained for further analysis as a component of other identified alternatives in Section 7.4, are not expected to sufficiently address the RAOs. The rerouting of Little Squalicum Creek was deemed an appropriate surface water control for the LSC



Site to prevent continued erosion of contaminated material. However, rerouting the creek alone would not likely reduce the potential for direct human and/or ecological exposure, as contaminated material would be left in place.

### 7.3.4 Management and/or Treatment of Contaminated Material

This section provides a brief description of the following management and treatment technologies for contaminated material considered for the LSC Site:

- Stabilization/Containment
- Excavation and Removal to an Onsite Location for Consolidation
- Excavation and Removal to an Onsite Location for Bioremediation
- Excavation and Removal to an Onsite Location for Phytoremediation
- Excavation and Removal to an Offsite Commercial Landfill Facility

### Stabilization/Containment

Stabilization/containment technologies for application at contaminated sites include landfill covers (caps), vertical barriers, and horizontal barriers. Stabilization/containment is most likely applicable for (1) wastes that are low-hazard or immobile, (2) wastes that have been treated to produce low-hazard to low-mobility waste for onsite disposal, and (3) wastes whose mobility must be reduced as a temporary measure to mitigate risk until a permanent solution can be tested and implemented (EPA 1997c). Stabilization/containment is considered an established technology at sites where moderate volumes of largely immobile contaminants are the primary concern.

Caps reduce human contact, control fugitive dust emissions, improve aesthetics, and provide a stable surface over the waste. Caps may also reduce surface water infiltration. A properly engineered cap can also be protective of both surface and subsurface ecological receptors. Consolidation and capping is an appropriate alternative when contaminated material is left onsite, since it prevents or reduces direct contact exposure from ingestion and inhalation.

Consolidation and capping uses standard equipment and employs demonstrated design methods. Cap construction costs depend on the number of components in the final cap system. For those sites where groundwater contamination is a concern, impermeable barriers may be installed. For example, *in situ* vertical barriers (e.g., slurry walls) may be installed to create an impermeable barrier oriented perpendicular to the ground surface and direction of groundwater flow, minimizing the movement of contaminated groundwater offsite and/or limiting the flow of uncontaminated groundwater onsite (EPA 1997c).

The most important advantages of stabilization/containment are: (1) surface caps and vertical barriers are relatively simple, can be implemented relatively quickly and at low cost, and can be more economical than excavation and removal of waste; (2) caps and vertical barriers can be readily applied to large areas or volumes of waste; (3) engineering control is achieved and may be a final action if contaminants are well immobilized and potential receptors are distant; and (4) in



many cases it may be possible to create a land surface that can support vegetation and/or be appropriate for other purposes (EPA 1997c).

Disadvantages of stabilization/containment include: (1) design life is uncertain;

- (2) contamination remains onsite and is available to migrate if containment fails;
- (3) long-term inspection, maintenance, and monitoring are required; and (4) the site must be amenable to effective monitoring (EPA 1997c).

Site-Specific Evaluation: Consolidation and capping would be an appropriate action for the LSC Site if excavation and disposal or treatment actions are cost-prohibitive, or if alternative actions are deemed too difficult to implement. Consolidation and capping may also be appropriate in areas where lower levels of contamination are present and where the environmental impacts of removal outweigh the benefit. Migration of COPCs via groundwater is not a concern at the Site based on available data; therefore, impermeable barriers are not included in capping and consolidation actions considered in this EE/CA.

Capping would involve placing clean fill and rock material over the contaminated material to limit the potential for human and ecological exposure and limit the potential for offsite migration. The capping configuration would be graded so that drainage would follow the natural contours of the area. Controls for surface water and erosion would limit the potential for degradation of the cover. Although capping would not reduce the toxicity or volume of contamination, it would reduce direct exposure, risk, and mobility by making the contamination inaccessible to human and ecological receptors. For these reasons, this technology is retained for evaluation.

### **Excavation and Removal to an Onsite Location for Consolidation**

This alternative involves excavation, relocation, and placement of contaminated material in an onsite consolidation location. Under this alternative, the onsite consolidation cell would be selected based on available surface area, geologic conditions, groundwater table elevation, surface drainage area, and other relevant factors.

Excavated contaminated material would be transferred to the onsite consolidation cell and compacted to a reasonably dense volume. Consolidation cell designs often include appropriate controls such as a barrier layer, leachate collection system, surface water controls, and site security and/or fencing, as needed.

Upon completion of contaminated material placement, final grading would be completed and final cover layers would be placed, leaving the consolidation cell in a condition of orderliness and pleasing aesthetic appearance. Final grading would promote surface water runoff and protect against erosion. Final cover layers often include a low-permeability layer, as well as rooting and seed bed layers to support native plant growth. Establishment of a vegetative cover over the consolidation cell, and transpiration and interception processes would further reduce infiltration and erosion. Removal and placement of the contaminated



material into the onsite consolidation cell would substantially reduce the potential exposure to human and ecological receptors.

Site-Specific Evaluation: Relocation of the contaminated material to a controlled environment would eliminate potential unchecked migration of contaminants and reduce the size of an onsite cap. The final cover system of the onsite consolidation cell would reduce the potential for contaminant transportation via surface water and air pathways. Because migration of COPCs via groundwater is not a concern at the Site based on available sample data, impermeable barriers are not included in cover systems considered in this EE/CA. Removal and placement of the contaminated material into an onsite consolidation cell would substantially reduce the potential exposure to human and ecological receptors. This alternative provides a high potential for RAO and ARAR achievement and is retained for further evaluation.

### **Excavation and Removal to an Onsite Location for Bioremediation**

This alternative involves excavation, relocation, and placement of contaminated material in an onsite location for bioremediation. Bioremediation has been selected most frequently to address organic contamination at wood treatment facility Superfund sites, and is believed to effectively treat wood-treating wastes at a relatively low cost (EPA 1995).

Bioremediation is the chemical degradation of organic contaminants using microorganisms. Biological activity (i.e., biodegradation) can occur either in the presence or absence of oxygen (aerobic or anaerobic conditions, respectively). Aerobic biodegradation converts organic contaminants to various intermediate and final decomposition products, which may include various daughter compounds, carbon dioxide, water, humic materials, and microbial cell matter. Aerobic biodegradation may also cause binding of the contaminants to soil components, such as humic materials. Anaerobic biodegradation converts the contaminants to carbon dioxide, methane, and microbial cell matter (EPA 1995).

Bioremediation may be an *ex situ* or *in situ* process. *Ex situ* bioremediation refers to biological treatment of contaminants following excavation of the soil or other media, and includes composting, land treatment in lined treatment cells, treatment in soil piles, or the use of soil slurry reactors. *In situ* bioremediation is in-place treatment of contaminants, and may involve the addition of nutrients, oxygen, or other enhancements to the subsurface. In general, *ex situ* bioremediation is faster than *in situ* bioremediation, although the implementation of either *ex situ* or *in situ* bioremediation typically requires several years (EPA 1995).

The effectiveness of bioremediation is site-specific. Careful contaminant characterization, together with treatability studies of appropriate scale and duration, are strongly recommended. Bioremediation can effectively treat soils, sediments, and sludges contaminated with organic contaminants such as halogenated phenols and cresols, other polar organic compounds, non-halogenated aromatics, and PAHs. Only limited data on the bioremediation of dioxins or furans are currently available (EPA 1995).



Site-Specific Evaluation: Bioremediation is commonly used at wood treatment waste sites, and can be very effective at a relatively low cost, depending on the site conditions. In situ bioremediation was not considered in this alternative because it could result in contamination being left in place that could not be treated effectively. Ex situ bioremediation was considered; however, dioxins/furans are a COPC at the LSC Site, and the effectiveness of bioremediation for the treatment of dioxins/furans has not been well documented. In addition, the area required for bioremediation of the quantity of contaminated material to be excavated is not available. For these reasons, this technology is not retained for evaluation.

### **Excavation and Removal to an Onsite Location for Phytoremediation**

This alternative involves excavation, relocation, and placement of contaminated material in an onsite location for phytoremediation (use of plants to reduce contamination). Phytoremediation is an attractive treatment technology due to the relatively low cost of implementation and maintenance and the aesthetics of the plantings. However, the effectiveness of phytoremediation is site-specific, depending on available space for plantings, the proper climate for their growth, and the type and depth of contaminants. In addition to suitable site conditions, the success of phytoremediation relies on the selection of appropriate plant species depending on water uptake rates, chemical tolerance, climate tolerance, growth rates, transpiration rates, chemical assimilation ability, and regulatory acceptance.

Phytoremediation is classified based on the mechanism used to achieve contaminant fate. These mechanisms may include phytostabilization, rhizodegradation, phytoaccumulation, phytodegradation, phytovolatilization, and evapotranspiration. Additional phytotechnologies exist that include vegetative covers, groundwater hydraulic barriers, treatment wetlands, riparian buffers, and hydroponic systems (rhizofiltration; ITRC 2001, EPA 2000a, EPA 2001).

Studies have shown that degradation of PCP and PAHs occurs in the root zone of the plant; this degradation is termed rhizodegradation or rhizosphere bioremediation. The fate of dioxins/furans is not well understood but may incorporate a mix of phytostabilization, rhizodegradation, and phytoaccumulation (Schnoor 1997).

Phytoremediation of PCP- and PAH-contaminated soils has been demonstrated at various treatment sites in both bench-scale and full-scale experiments, although the complete fate and transport of these contaminants has not been determined (EPA 2000a, EPA 2001, Aprill and Sims 1990, Bossert and Bartha 1984, Cunningham and Ow 1996, Schnoor 2002).

Phytoremediation fate and transport of dioxins/furans has rarely been reported. A pilot-scale study conducted on dioxin/furan-contaminated sediment from the Saginaw River, Michigan, showed that standard land farming techniques could not degrade dioxins (Meyers et al. 2003) and it has not been reported that phyto-assisted land farming is able to degrade dioxins. Several published articles and



onsite data suggest that dioxins are taken up by roots and translocated to other plant structures. There is no indication of the ultimate fate of this contaminant; it appears that dioxins/furans are simply being moved from the subsurface to the surface (Schnoor 1997, Jou et al. 2007).

**Site-Specific Evaluation:** Phytoremediation is an attractive treatment technology due to the relatively low cost to implement and maintain and the aesthetics of the plantings. However, similar to bioremediation, because dioxins/furans are primary COPCs at the LSC Site and the effectiveness of phytoremediation for the treatment of dioxins/furans has not been demonstrated, this technology is not retained for evaluation.

### **Excavation and Removal to an Offsite Commercial Disposal Facility**

This alternative involves excavation, relocation, and placement of the waste materials in an offsite commercial disposal facility. Under this alternative, the location of the offsite facility would be selected based on the classification of contaminated material as hazardous or non-hazardous, availability of landfill space, haul distance, and cost. The facility would be permitted for solid waste (non-hazardous) or hazardous waste if appropriate, and would be able to accept the contaminated material without substantial facility modifications. The facility would be responsible for compliance with all applicable regulations governing solid waste disposal, which might include site security, fencing, daily cover, groundwater monitoring, explosive gas generation, leachate collection, and hazardous waste characterization.

Site-Specific Evaluation: Relocation of the contaminated material to a controlled environment would eliminate any unchecked migration of contaminants. The offsite commercial facility would be responsible for installation of a cover system to reduce the potential for contaminant transportation via the surface water, groundwater, and air pathways. Removal and placement of the contaminated material into an offsite commercial facility would substantially reduce the potential exposure to human and ecological receptors. This alternative provides a high potential for RAO and ARAR achievement and is retained for further evaluation.

### 7.4 Assembly of Removal Action Alternatives

The general response actions and technologies described in the preceding sections have been assembled into five removal action alternatives that have been analyzed with respect to the evaluation criteria. These alternatives have been developed based on the known nature and extent of soil/sediment contamination and results of the human and ecological risk assessments. The No Action Alternative has been included for comparison. The five alternatives are:

- Alternative 1 No Action
- Alternative 2 Excavation and Offsite Disposal or Consolidation on the Oeser Property



- Option A Disposal at a Subtitle D (Non-Hazardous Waste)
   Landfill
- o Option B Disposal at a Subtitle C (Hazardous Waste) Landfill
- o Option C Consolidation on the Oeser Property
- Alternative 3 Excavation, Consolidation, Capping, and Creek Reroute
- Alternative 4 Excavation, Consolidation, Capping, and Creek Reroute back through Historical Creek Channel
- Alternative 5 Excavation, Consolidation, Capping, and Long Creek Reroute back through Historical Creek Channel

Note that Alternative 2 is divided into three options. The likelihood is that Alternative 2, if implemented, would consist of some combination of the three options, rather than solely Option A, B, or C. The actual combination of Alternative 2 would depend on how much of the contaminated material is hazardous and on limits on the capacity for contaminated material consolidation at the Oeser property. Cost estimates have been prepared for each option individually to assess the possible range of costs under Alternative 2.

#### 7.4.1 Alternative 1: No Action

Alternative 1 would leave contaminated material at the LSC Site in its current condition and assumes no further intervention would occur. Under Alternative 1, no response activities or monitoring would occur at the LSC Site.

### **Effectiveness**

This alternative would not be effective in protecting human health or ecological receptors, would not attain ARARs, and would not meet RAOs. Alternative 1 would not reduce the risk to human health through inhalation, ingestion, or dermal contact pathways. Furthermore, the toxicity, mobility, and volume of contaminants would not be reduced under this alternative.

### **Implementability**

This alternative is technically implementable; however, this alternative would likely not be acceptable to the regulatory agencies or LSC Site stakeholders given that contaminated material poses an unacceptable risk to human health and ecological receptors based on the elevated concentrations of PCP, cPAHs, TPAHs, and dioxins/furans. Technical and administrative feasibility criteria do not apply to the No Action Alternative.

#### Cost

There are no costs associated with this alternative.

### 7.4.2 Alternative 2, Option A: Excavation and Offsite Disposal at a Subtitle D (Non-Hazardous Waste) Landfill

Alternative 2, Option A, includes the following:



- Excavation of an estimated 10,113 CY of contaminated material from the removal action areas—approximately 3,134 CY from the Existing Creek Channel Removal Action Area, and 6,979 CY from the Historical Creek Channel Removal Action Area;
- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Backfilling of excavations using clean material excavated from the Estuary Area;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation;
- Characterization sampling of excavated material for acceptance at a Subtitle D (non-hazardous waste) landfill; and
- Transportation of the excavated material to the landfill.

The following description of Alternative 2, Option A, and its implementation, is based on assumptions used for analysis in this EE/CA. The actual approach would be refined following selection of the preferred removal action alternative. Construction Best Management Practices (BMPs) would be implemented during the removal action.

The cost estimate for Alternative 2, Option A, including a list of assumptions, is provided in Appendix D (Table D1). Typical cross sections are included in Figure 11, and a conceptual design of Alternative 2 is presented in Figure 12. Figure 12 depicts the different depths of excavation within the removal action areas. The excavation depths were determined as described in Section 3.

Prior to excavation of contaminated material, the removal action areas would be cleared and grubbed using a bulldozer or other suitable equipment. To better delineate the extent of contamination in the excavation area, soil sampling would be performed. Sampling may occur during rather than before excavation, but for cost estimating purposes, pre-excavation sampling was assumed. Such costs have been estimated based on the following approach. Contamination delineation sampling would begin at the upstream end of the LSC Site so that excavation could commence following sampling in a particular reach and continued contamination delineation sampling could be conducted ahead of the excavation operations. Collection of a total of 400 samples is estimated for onsite screening—at least one sample location per 625-square-foot (25-by-25-foot) area, and an estimated three samples per sample location. For quick and accurate field screening results, contamination delineation samples would be analyzed in an onsite trailer for PCP and PAHs using RaPID ® Assay immunoassay test kits. Twenty percent of the samples would be confirmed by an offsite laboratory. Each of the estimated 80 samples sent to the laboratory for confirmation would be analyzed for PCP by EPA Method 8151, PAHs by EPA Method 8270 selective ion monitoring (SIM), and dioxins/furans by EPA Method 8290. This sampling



approach, including numbers and types of samples, was developed for the purpose of analysis in this EE/CA. For EE/CA costing purposes, it was assumed that subsurface soil/sediment sample collection would be performed using a hand auger. An actual sampling approach will be refined as appropriate.

Excavation would be conducted using an excavator. Excavated soil/sediment would be loaded directly into a dump truck and hauled to a designated location at the LSC Site for dewatering and stockpiling. A loader would be used to manage the stockpile. A water diversion system would be put in place during excavation in the Existing Creek Channel; the system would consist of a pump behind an earthen dam at the upstream end of the excavation, from which water would be pumped through a hose to a settling pond at the downstream end of the excavation.

Following excavation of the contaminated material volume delineated through pre-excavation onsite screening, confirmation samples would be collected from the sidewalls of the excavation and the bottom of the excavation for excavated depths less than 6 feet. Additional excavation would be conducted as needed to remove all contaminated material that poses a risk to receptors up to a depth of 6 feet. A total of 370 samples is assumed — one sample every 25 feet along the excavation sidewalls one sample every 625-square-foot area for the excavation bottom. Although confirmation sampling at the base of the excavation at a 6-foot depth is not expected, to simplify EE/CA costing, the total excavation area was assumed. An actual sampling approach will be refined as appropriate.

Clean backfill material would be excavated from the Estuary Area. As indicated above, in September 2009, for the COB, Coastal Geological Services installed 4 soil borings in the Estuary Area in support of an estuary feasibility study. A slight to moderate diesel odor and slight sheen were observed at 2.5 feet bgs at the northernmost boring location, near the Marine Drive Bridge. For this EE/CA, the majority of the Estuary Area is assumed to be appropriate for use as clean backfill material. During implementation of the removal action, in addition to monitoring the soil for visual or olfactory evidence of petroleum contamination, an onsite construction oversight engineer would field-screen the soil using a photoionization detector (PID) or flame ionization detector (FID).

Clean backfill material would be hauled directly to the area requiring backfill, and compacted in 6-inch lifts using a vibrating roller. Following backfill of the removal action areas, the areas would be restored. For analysis in this EE/CA, a 3-inch layer of habitat mix (sand/gravel of a particular gradation to be determined) would be placed along the Existing Creek Channel. An estimated 74 CY of habitat mix material would be imported and stockpiled at the LSC Site. A dump truck would be used to haul the material to the creek channel, and a dozer would be used to spread the material. Engineering design would be required to determine the details of restoration needed in the creek channel during the removal action



The Estuary Area and the remaining disturbed area within the removal action areas would be revegetated. For analysis in this EE/CA, it is assumed that the Estuary Area would be revegetated by fertilization and seeding, and that the removal action would not include development of the proposed estuary in the Estuary Area following its use as a borrow area.

Impacted wetlands would be restored/mitigated. A wetland delineation would be performed prior to construction, and the details of wetland restoration/mitigation would be determined during the engineering design process. For this EE/CA, the approximate extent of the existing wetlands was estimated based on Figure 9 of the NES document Wetland Reconnaissance and Existing Conditions Report (NES 2009), and imported into AutoCAD Civil 3D. The approximate extent of existing wetlands is illustrated in Figure 12. Based on this estimated extent of wetlands in AutoCAD, a total of approximately 2 acres of wetlands exist at the LSC Site, and under Alternative 2, approximately one acre of wetlands would be impacted by excavation and fill. This includes the wetlands within and adjacent to the Historical Creek Channel and the wetland adjacent to the lower reach of the Existing Creek Channel. This is a conservative estimate, as uncontaminated wetlands would be avoided to the greatest extent possible during construction. Wetlands depicted in the Estuary Area would be avoided during the excavation of clean backfill material. For the purpose of analysis in this EE/CA, a wetland mitigation ratio of 1:1.5, and a wetland restoration cost of \$70,000 per acre are assumed. This cost is based on wetland construction costs at other sites. Wetland restoration/mitigation locations, design, and approaches would be developed following selection of the preferred removal action alternative.

Following dewatering of soil/sediment excavated from the removal action areas, characterization samples would be collected for offsite disposal of contaminated material at a Subtitle D Landfill (non-hazardous waste). (See Note above in Section 7.4 regarding Alternative 2). In case existing analytical data is not adequate to characterize the material, it is assumed that each sample would be analyzed by an offsite laboratory for PCP by EPA Method 8151, and for PAHs by EPA Method 8270 SIM. A swell factor of 15% was used to estimate approximately 11,630 CY of loose soil/sediment for offsite disposal. A typical sample density of one sample (composite) per 500 CY was used to estimate the number of samples required for characterization, resulting in an estimated 24 characterization samples. This sampling approach was developed for the purpose of analysis in this EE/CA, and would be refined as appropriate during the engineering design process.

For analysis under Alternative 2, Option A, excavated contaminated material is assumed to be non-hazardous waste, and would be transported by truck to the Greater Wenatchee Landfill for disposal. (See Note above in Section 7.4 regarding Alternative 2). According to Waste Management Northwest, the Greater Wenatchee Landfill is the closest Subtitle D Landfill to the LSC Site, and transportation by truck is most cost-effective. The Greater Wenatchee Landfill in Wenatchee, Washington, is approximately 194 miles (by road) southeast of the LSC Site. With an estimated 11,630 CY of contaminated material for offsite



disposal, it would take approximately 582 20-CY truck loads to transport all of the contaminated material to the Greater Wenatchee Landfill.

Transportation by train was considered due to the existing railroad access at the Oeser property; however, according to the contact at Waste Management Northwest, power issues associated with container transfer from the short track, delays caused by track switching, and potential delays due to other railroad traffic make transportation by train uneconomical.

### **Effectiveness**

This alternative provides a high level of environmental protection and long-term effectiveness, since all contaminated material that poses a risk to receptors, (i.e., contaminated material above a 6-foot depth) would be removed from the current exposed, uncontrolled environment to a permitted facility with all required landfill controls. It is possible that, soil/sediment impacted by COPCs may be left in place below a 6-foot depth at a limited number of locations (e.g., SB-31) following the removal action. Contaminated soil/sediment deeper than 6 feet is not proposed to be removed because it does not currently pose an unacceptable risk to ecological receptors. As stated in Section 4.1, applying conservative assumptions for evaluation of current risk to human receptors for exposure to subsurface soil - specifically calculating the 95 % UCL for the site as a whole and using all soil samples from depths from 0 to 15 feet bgs to calculate the 95% UCL calculation - the cancer risk for exposure to subsurface soil currently is 1.3 x 10-5. Following a removal action that includes excavation of contaminated soil/sediment from 0 to 6 feet bgs, the site-wide risk would be significantly lower than 1.3 x 10-5.

This alternative meets the RAOs and ARARs. The onsite potential for human and ecological exposure through inhalation, ingestion or dermal contact would be eliminated, and contaminant migration via surface runoff or soil or wind erosion would be prevented.

In the short term, the impacts to human health and ecological receptors that could occur during construction would include potential exposure to contaminants through fugitive dust emissions, surface water runoff, and spillage during hauling. However, these impacts could be controlled using fencing, institutional controls as described earlier (e.g., warning signs and public education), and BMPs, such as use of a water truck and sedimentation ponds.

Implementation of Alternative 2 would have short-term impact on vehicular traffic, requiring coordination with the LSC Site stakeholders. There would be continuous hauling of contaminated material from the LSC Site, and with an estimated 11,630 CY of contaminated material for offsite disposal, it would take approximately 582 20-CY truck loads to transport all the contaminated material to the Greater Wenatchee Landfill.



### **Implementability**

The activities associated with this alternative are technically feasible using standard methods and procedures. The necessary equipment, personnel, and services are readily available to support implementation of this alternative. Excavation and offsite disposal is a widely used remediation method and can be implemented in a relatively short period of time.

This alternative is administratively feasible. According to 40 CFR § 300.415, onsite removal actions conducted under CERCLA are required to attain ARARs to the extent practicable. Onsite removal actions must comply with the substantive requirements of the ARARs, but are not required to comply with administrative requirements (requirements that facilitate the implementation of substantive requirements of a statute or regulation, such as permits). That is, for implementation of the removal action at the LSC Site, the EPA must meet the substantive requirements of the ARARs, but does not need to obtain any permits. Compliance with laws in all respects is required for the offsite disposal of contaminated material.

Wetlands existing at the LSC Site within the removal action areas would be disturbed under this alternative. Sections 401 and 404 of the Clean Water Act (CWA) pertain to wetlands and thus are potential ARARs.

### Cost

The estimated cost to implement this alternative is \$3,342,700 in 2009 dollars. The cost includes direct and indirect capital costs. Annual PRSC costs are not applicable for this alternative. (See Note above in Section 7.4 regarding Alternative 2).

The cost estimate was developed using unit prices contained in RS Means Heavy Construction Cost Data (RSMeans 2009), vendor quotes, and guidance provided in the EPA document A Guide to Developing and Documenting Cost Estimates during the Feasibility Study (EPA 2000b). The estimated cost includes an extra 25% for contingencies.

### 7.4.3 Alternative 2, Option B: Excavation and Offsite Disposal at a Subtitle C (Hazardous Waste) Landfill

Alternative 2, Option B is identical to Alternative 2, Option A, except that excavated contaminated material is assumed to be hazardous waste, requiring disposal at a Subtitle C Landfill. (See Note above in Section 7.4 regarding Alternative 2). Alternative 2, Option B includes the following:

 Excavation of an estimated 10,113 CY of contaminated material from the removal action areas—approximately 3,134 CY from the Existing Creek Channel Removal Action Area and 6,979 CY from the Historical Creek Channel Removal Action Area;



- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Backfilling of excavations using clean material excavated from the Estuary Area;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation; and
- Transportation of the excavated material to the landfill.

Other than the differences discussed below, the implementation of Alternative 2, Option B would be identical to that described for Alternative 2, Option A. The cost estimate for Alternative 2, Option B is provided in Appendix D (Table D2).

For analysis of Alternative 2, Option B, it is assumed that excavated contaminated material would be transported by truck to the Chemical Waste Management of the Northwest (Arlington) Landfill for disposal. (See Note above in Section 7.4 regarding Alternative 2). The Arlington Landfill is located in Arlington, Oregon, approximately 356 miles by road southeast of the LSC Site. Characterization requirements for disposal at a Subtitle C Landfill are different from those for disposal at a Subtitle D Landfill. Existing analytical data would likely be sufficient for characterization of soil/sediment excavated from the LSC Site; therefore, it is assumed that no additional characterization sampling would be required under Alternative 2, Option B.

As for Alternative 2, Option A, a swell factor of 15% was used to estimate approximately 11,630 CY of loose soil/sediment for offsite disposal. With 11,630 CY of contaminated material for offsite disposal, it would take approximately 582 20-CY truck loads to transport all the contaminated material to the Arlington Landfill.

#### Effectiveness

Effectiveness would be identical to that described for Alternative 2, Option A.

### **Implementability**

Implementability would be identical to that described for Alternative 2, Option A.

#### Cost

The estimated cost to implement this alternative is \$7,530,400 in 2009 dollars. The cost includes direct and indirect capital costs. The cost estimate was developed using the same references and similar assumptions as for Alternative 2, Option A. (See Note above in Section 7.4 regarding Alternative 2).



### 7.4.4 Alternative 2, Option C: Excavation and Consolidation on the Oeser Property

Alternative 2, Option C is similar to Alternative 2, Options A and B, except that excavated contaminated material would be consolidated at the Oeser property rather than transported to a landfill for disposal. (See Note above in Section 7.4 regarding Alternative 2). Alternative 2, Option C includes the following:

- Excavation of an estimated 10,113 CY of contaminated material from the removal action areas—approximately 3,134 CY from the Existing Creek Channel Removal Action Area and 6,979 CY from the Historical Creek Channel Removal Action Area:
- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Backfill of excavations using clean material excavated from the Estuary Area;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation; and
- Hauling and consolidation of contaminated material in a repository at the Oeser property.

Other than the differences discussed below, the implementation of Alternative 2, Option C would be identical to that described for Alternative 2, Option A. The cost estimate for Alternative 2, Option C is provided in Appendix D (Table D3).

For analysis under Alternative 2, Option C, it is assumed that excavated contaminated material would be hauled by truck to the Oeser property. As for Alternative 2, Option A, a swell factor of 15% was used to estimate approximately 11,630 CY of loose soil/sediment for consolidation in a repository.

An area comprising approximately 4 acres is expected to be available at the Oeser property for construction of a repository (Secrist 2010). Dewatered excavated soil/sediment would be loaded into a dump truck and hauled from the LSC Site to the Oeser property repository location, where a loader would spread the material and a vibrating roller would compact it in 6-inch lifts. If the capacity for contaminated material at the Oeser property is reached, excess contaminated material would be shipped off-site to the appropriate facility (determined based on whether the material is hazardous).

The repository cover would consist of geotextile demarcation material placed above contaminated soil/sediment, followed by a 6-inch layer of 4-inch minus rock. The layer of rock is referred to as the Biotic Barrier Layer, as its main function is to protect ecological receptors from contact with contaminated material. The Biotic Barrier Layer would be overlain by geotextile filter fabric,



followed by a 2-foot layer of compacted soil. The geotextile filter fabric would prevent the soil layer from filling the voids in the Biotic Barrier Layer. Soil required for construction of the repository cover would be excavated from the Estuary Area; an estimated 6,453 CY is required. The repository would be sloped to drain.

### **Effectiveness**

Similar to Alternative 2, Option A, this alternative provides a high level of environmental protection and long-term effectiveness, since all contaminated material that poses a risk to receptors, (i.e., contaminated material above a 6-foot depth) would be removed from the current exposed, uncontrolled environment and placed in an engineered repository at the Oeser property. It is possible that, soil/sediment impacted by COPCs may be left in place below a 6-foot depth at a limited number of locations (e.g., SB-31) following the removal action. Contaminated soil/sediment deeper than 6 feet is not proposed to be removed because it does not currently pose an unacceptable risk to ecological receptors. As stated in Section 4.1, applying conservative assumptions for evaluation of current risk to human receptors for exposure to subsurface soil - specifically calculating the 95 % UCL for the site as a whole and using all soil samples from depths from 0 to 15 feet bgs to calculate the 95% UCL calculation - the cancer risk for exposure to subsurface soil currently is 1.3 x 10-5. Following a removal action that includes excavation of contaminated soil/sediment from 0 to 6 feet bgs, the site-wide risk would be significantly lower than 1.3 x 10-5.

This alternative meets the RAOs and ARARs. The onsite potential for human and ecological exposure through inhalation, ingestion or dermal contact would be eliminated, and contaminant migration via surface runoff or soil or wind erosion would be prevented.

As described for Alternative 2, Option A, in the short term, the impacts to human health and ecological receptors that could occur during construction would include potential exposure to contaminants through fugitive dust emissions, surface water runoff, and spillage during hauling. However, these impacts could be controlled using fencing, institutional controls as described earlier (e.g., warning signs and public education), and BMPs, such as use of a water truck and sedimentation ponds.

Although, for purposes of the assumptions made in this EE/CA, excavated contaminated material would not be hauled to an offsite disposal facility, implementation of Alternative 2, Option C would still have short-term impacts on vehicular traffic, as hauling of excavated contaminated material would occur between the LSC Site and the Oeser property for consolidation on the Oeser property.

#### **Implementability**

Oeser has identified a 4-acre surface area that would be available for construction of a repository. Height restrictions for site operations and other property characteristics would limit the height of the repository, and therefore the volume

of contaminated material that could be consolidated at the Oeser property. As stated above, if the capacity for contaminated material at the Oeser property is reached, excess contaminated material would be shipped off-site to the appropriate facility (determined based on whether the material is hazardous).

The activities associated with this alternative are technically feasible using standard methods and procedures. The necessary equipment, personnel, and services are readily available to support implementation of this alternative.

This alternative is administratively feasible, and would require the EPA to meet the ARARs described for Alternative 2, Options A and B, with the exception of those pertaining to offsite disposal.

#### Cost

The estimated cost to implement this alternative is \$2,066,200 in 2009 dollars. The cost includes direct and indirect capital costs. The cost estimate was developed using the same references and similar assumptions as for Alternative 2, Options A and B.

### 7.4.5 Alternative 3: Excavation, Consolidation, Capping, and Creek Reroute

Alternative 3 would involve excavation, consolidation, capping, and creek rerouting, and would include:

- Excavation of an estimated 1,760 CY of contaminated material from the Existing Creek Channel Removal Action Area;
- Placement of 1,760 CY excavated contaminated material within the middle reach of the Existing Creek Channel (repository area) prior to capping;
- Excavation of the New Upper Creek Channel;
- Backfilling of excavations using clean material excavated to create the New Upper Creek Channel, and additional material excavated from the Estuary Area;
- Capping of the middle reach of the Existing Creek Channel and the Historical Creek Channel using clean material excavated to create the New Upper Creek Channel, and additional material excavated from the Estuary Area;
- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation; and
- Annual PRSC (maintenance of the repository and cap areas).



The following description of Alternative 3 and its implementation is based on assumptions used for analysis in this EE/CA. As for Alternative 2, the actual approach would be refined following the selection of the preferred removal action alternative. Construction BMPs would be implemented during the removal action

The cost estimate for Alternative 3, including a list of assumptions, is provided in Appendix D (Table D4). Typical cross sections are provided in Figure 11, and a conceptual design of Alternative 3 is presented in Figure 13. Figure 13 depicts the excavation areas and depths, the repository/cap areas, and the route for the New Upper Creek Channel. The volume calculations for Alternative 3 are included in Appendix B.

As in Alternative 2, prior to excavation of contaminated material, the removal action areas would be cleared and grubbed using a bulldozer or other suitable equipment. To better delineate the extent of contamination in the excavation area, soil sampling would be performed. Sampling may occur during rather than before excavation, but for cost estimating purposes, pre-excavation sampling was assumed. Such costs have been estimated based on the following approach. Collection of a total of 80 samples is estimated for onsite screening—at least one sample location every 625-square-foot area, with an estimated three samples per location. For quick and accurate field screening results, contamination delineation samples would be analyzed in an onsite trailer for PCP and PAHs using RaPID ® Assay immunoassay test kits. Twenty percent of the samples would be confirmed by an offsite laboratory. Each of the estimated 16 samples sent to the laboratory for confirmation would be analyzed for PCP by EPA Method 8151, PAHs by EPA Method 8270 SIM, and dioxins/furans by EPA Method 8290. This sampling approach, including numbers and types of samples, was developed for the purpose of analysis in this EE/CA. For EE/CA costing purposes, it was assumed that subsurface soil/sediment sample collection would be performed using a hand auger. An actual sampling approach will be refined as appropriate.

First, the lower reach of the Existing Creek Channel would be excavated and backfilled with clean material. Then the New Upper Creek Channel would be excavated prior to excavation and capping of the upper Existing Creek Channel so the creek could be diverted to the new channel to allow for excavation and capping in the upper Existing Creek Channel. The New Upper Creek Channel is assumed to have a cross-sectional area of a trapezoid with side slopes of 3H:1V, and a bottom width of 5 feet (see Figure 11).

Clean material excavated for the New Upper Creek Channel would be stockpiled onsite for use as backfill and cap material. Additional clean fill material would be excavated from the Estuary Area. To obtain the estimated 10,401 CY required to backfill and cap removal action areas, an estimated 7,375 CY would need to be excavated from the Estuary Area. An onsite construction oversight engineer would field-screen the soil excavated from both the New Upper Creek Channel



and the Estuary Area to confirm that it was clean for use as backfill and cap material. In addition to monitoring the soil for visual or olfactory evidence of petroleum contamination, an onsite construction oversight engineer would field-screen the soil using a PID or FID.

Following excavation of the New Upper Creek Channel, creek discharge would be diverted into the New Upper Creek Channel. Contaminated soil/sediment would be excavated from the area immediately downstream of the box culvert and the lower reach of the Existing Creek Channel, loaded into a dump truck, and placed directly within the middle reach of the Existing Creek Channel to be capped over in a repository. A water diversion system would be put in place during excavation of contaminated soil/sediment in the lower reach of the Existing Creek Channel. As in Alternative 2, following excavation of the contaminated material volume delineated through pre-excavation onsite screening, confirmation samples would be collected from the sidewalls of the excavation and the bottom of the excavation for excavated depths less than 6 feet. Additional excavation would be conducted as needed to remove all contaminated material that poses a risk to receptors up to a depth of 6 feet. A total of 120 samples is assumed for Alternative 3—one sample every 25 feet along the excavation sidewalls one sample every 625-square-foot area for the excavation bottom. Although confirmation sampling at the base of the excavation at a 6-foot depth is not expected, to simplify EE/CA costing, the total excavation area was assumed. An actual sampling approach will be refined as appropriate.

Excavated areas would be backfilled with clean material stockpiled from the excavation of the New Upper Creek Channel. Stockpiled clean material would be loaded into a dump truck by a loader, hauled to the areas requiring backfill, and compacted in 6-inch lifts using a vibrating roller.

A cap would be constructed in the middle reach of the Existing Creek Channel and in the Historical Creek Channel Removal Action Area, as portrayed in Figure 13. Prior to capping, geotextile demarcation material would be placed to separate contaminated material from clean cap material. The geotextile demarcation material would be overlain by a 6-inch layer of 4-inch minus rock, the Biotic Barrier Layer, as described for Alternative 2, Option C. The Biotic Barrier Layer would be overlain by geotextile filter fabric, followed by a 2-foot layer of compacted soil. Capped areas would be sloped to drain.

As illustrated in Appendix D (Table D4), approximately 1,193 CY of 4-inch minus rock is required for the Biotic Barrier Layer. The 4-inch minus rock would be imported and stockpiled at the LSC Site at a location to be determined during the engineering design process. A dump truck would be used to haul the material to the cap areas, and a dozer would be used to spread the material.

According to the volume calculations included in Appendix B, a total of 8,641 CY of clean cap material would be needed under this alternative. As discussed above, clean cap material would be stockpiled from excavation of the New Upper Creek Channel, and additional material would be excavated from the Estuary



Area. The material would be loaded into a dump truck and hauled to the capping location, where a loader would spread the cap material, and a vibrating roller would compact the material in 6-inch lifts. The soil layer would be 2 feet thick (after compaction) with 3H:1V side slopes (see Figure 11). In the middle reach of the Existing Creek Channel, the full thickness of the cap would extend 5 feet beyond the surveyed creek extent on each side. In the Historical Creek Channel Removal Action Area, the full thickness would extend 5 feet beyond the "Extent of Historical Creek" on each side. These limits may be changed based on the results of the planned additional soil sampling and analysis. The cap would then slope down at 3H:1V.

Following backfilling of excavated areas, capping, and excavation of the New Upper Creek Channel, disturbed areas would be restored. As in Alternative 2, it is estimated that a 3-inch layer of habitat mix (sand/gravel of a particular gradation to be determined) would be placed along the lower reach of the Existing Creek Channel and the New Upper Creek Channel. An estimated 284 CY of habitat mix material would be imported and stockpiled at the LSC Site at a location to be determined during the engineering design process. A dump truck would be used to haul the material to the creek channel, and a dozer would be used to spread the material. Following selection of the preferred alternative, engineering design would be employed to identify elements of stream design and restoration that may be necessary as part of the removal action. Such engineering design would evaluate potential impacts to groundwater flow that could result from rerouting the creek. As appropriate, design elements such as a French drain or impermeable barriers may be considered.

Under Alternative 3, approximately one acre of wetlands would be impacted during construction: 0.3 acres by excavation and fill, and 0.7 acres by capping. This estimate is conservative because uncontaminated wetlands would be avoided to the greatest extent possible during construction. As for Alternative 2, impacted wetlands would be restored/mitigated.

Annual PRSC would entail maintenance of the repository and cap areas. These areas would require mowing and weeding on an annual basis to ensure that trees were not allowed to grow substantial roots, which could compromise the integrity of the cap if roots were to penetrate the geotextile and the tree subsequently fell, resulting in exposure of soil contained within the root ball. No surface water or groundwater monitoring is expected.

#### **Effectiveness**

This alternative provides a high level of environmental protection and long-term effectiveness, since contaminated material would either be excavated or capped. This alternative meets the RAOs and ARARs. The onsite potential for human and ecological exposure through inhalation, ingestion, or dermal contact would be eliminated, and contaminant migration via surface runoff or soil or wind erosion would be prevented. Potential impacts to the groundwater flow regime would require further assessment during the engineering design.



In the short term, the impacts to human health and ecological receptors that could occur during construction would include potential exposure to contaminants through fugitive dust emissions and surface water runoff. However, these impacts could be controlled using fencing, institutional controls as described earlier (e.g., warning signs and public education), and BMPs such as use of a water truck and sedimentation ponds.

Implementation of Alternative 3 would have minimal short-term impact on vehicular traffic, as hauling of contaminated material from the LSC Site would not occur. Vehicular traffic would only occur during mobilization/demobilization of heavy equipment and during delivery of 4-inch minus rock and habitat mix material to the LSC Site.

### **Implementability**

The activities associated with this alternative are technically feasible using standard methods and procedures. The necessary equipment, personnel, and services are readily available to support implementation of this alternative. Capping is a widely used remediation method and can be implemented in a relatively short period of time.

This alternative is administratively feasible, and would require the EPA to meet the same ARARs as described for Alternative 2 except for those pertaining to offsite disposal. The removal action areas are the same for both alternatives, and would affect the same acreage of wetlands.

EPA has met and otherwise communicated with representatives of COB several times over the past six months. The COB representatives have indicated that this alternative is not desirable because they believe that it may not be compatible with future park development plans.

### Cost

The estimated cost to implement this alternative is \$1,150,100 in 2009 dollars. The cost includes direct and indirect capital costs and annual PRSC costs. The cost estimate was developed using the same references and similar assumptions as for Alternative 2.

# 7.4.6 Alternative 4: Excavation, Consolidation, Capping, and Creek Reroute back through Historical Creek Channel

As for Alternative 3, this alternative would include excavation, consolidation, capping, and creek rerouting; however, under this alternative, the creek would be rerouted back through the Historical Creek Channel, where contamination currently exists. Alternative 4 would include the following:

• Excavation of an estimated 5,272 CY of contaminated material from the removal action areas—approximately 1,760 CY from the Existing Creek



Channel Removal Action Area and 3,512 CY from the Historical Creek Channel Removal Action Area;

- Placement of 5,272 CY excavated contaminated material within the middle reach of the Existing Creek Channel (repository area) prior to capping;
- Excavation of the New Upper Creek Channel;
- Backfill of excavations using clean material excavated to create the New Upper Creek Channel, and additional material excavated from the Estuary Area;
- Capping of the middle reach of the Existing Creek Channel and the Historical Creek Channel using clean material excavated to create the New Upper Creek Channel, and additional material excavated from the Estuary Area;
- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation; and
- Annual PRSC (maintenance of the repository and cap areas).

The cost estimate for Alternative 4, including a list of assumptions, is provided in Appendix D (Table D5). Typical cross sections are provided in Figure 11, and a conceptual design of Alternative 4 is presented in Figure 14. Figure 14 depicts the excavation areas and depths, the repository/cap areas, and the route for the New Upper Creek Channel. The volume calculations for Alternative 4 are included in Appendix B.

As in Alternatives 2 and 3, prior to excavation of contaminated material, the removal action areas would be cleared and grubbed using a bulldozer or other suitable equipment. To better delineate the extent of contamination in the excavation area, soil sampling would be performed. Sampling may occur during rather than before excavation, but for cost estimating purposes, pre-excavation sampling was assumed. Such costs have been estimated based on the following approach. Collection of a total of 250 samples is estimated for onsite screening at least one sample location every 625-square-foot area, with an estimated three samples per location. Contamination delineation samples would be analyzed in an onsite trailer for PCP and PAHs using RaPID ® Assay immunoassay test kits, and 20% of the samples would be confirmed by an offsite laboratory. Each of the estimated 50 samples sent to the laboratory for confirmation would be analyzed for PCP by EPA Method 8151, PAHs by EPA Method 8270 SIM, and dioxins/furans by EPA Method 8290. This sampling approach, including numbers and types of samples, was developed for the purpose of analysis in this EE/CA. For EE/CA costing purposes, it was assumed that subsurface



soil/sediment sample collection would be performed using a hand auger. An actual sampling approach will be refined as appropriate.

As for Alternative 3, first, the lower reach of the Existing Creek Channel would be excavated and backfilled with clean material. Then the New Upper Creek Channel would be excavated so that the creek could be diverted to the new channel to allow for excavation and capping in the upper Existing Creek Channel. As mentioned above, the New Upper Creek Channel is assumed to have a cross sectional area of a trapezoid with a side slope of 3H:1V, and a bottom width of 5 feet (see Figure 11). Under Alternative 4, only the uppermost portion of the New Upper Creek Channel would be aligned with that channel as it is described for Alternative 3.

Clean material excavated for the New Upper Creek Channel would be stockpiled onsite for use as backfill and cap material. Additional clean fill material would be excavated from the Estuary Area. Under Alternative 4, to obtain the estimated 8,736 CY required to backfill and cap removal action areas, an estimated 7,264 CY would need to be excavated from the Estuary Area. As in Alternative 3, an onsite construction oversight engineer would field-screen the soil excavated from both the New Upper Creek Channel and the Estuary Area to confirm that it was clean for use as backfill and cap material. In addition to monitoring the soil for visual or olfactory evidence of petroleum contamination, an onsite construction oversight engineer would field-screen the soil using a PID or FID.

As in Alternative 3, following excavation of the New Upper Creek Channel, creek discharge would be diverted into the New Upper Creek Channel. Contaminated soil/sediment would be excavated from the area immediately downstream of the box culvert and the lower reach of the Existing Creek Channel, loaded into a dump truck, and placed directly within the middle reach of the Existing Creek Channel to be capped over in a repository. A water diversion system would be put in place during excavation of contaminated soil/sediment in the lower reach Existing Creek Channel. As in Alternatives 2 and 3, following excavation of the contaminated material volume delineated through pre-excavation onsite screening, confirmation samples would be collected from the sidewalls of the excavation and the bottom of the excavation for excavated depths less than 6 feet. Additional excavation would be conducted as needed to remove all contaminated material that poses a risk to receptors up to a depth of 6 feet. A total of 250 samples is assumed for Alternative 4—one sample every 25 feet along the excavation sidewalls one sample every 625-square-foot area for the excavation bottom. Although confirmation sampling at the base of the excavation at a 6-foot depth is not expected, to simplify EE/CA costing, the total excavation area was assumed. An actual sampling approach will be refined as appropriate.

As described for Alternative 3, excavated areas would be backfilled with clean material stockpiled from the excavation of the New Upper Creek Channel. Stockpiled clean material would be loaded into a dump truck by a loader, hauled to the areas requiring backfill, and compacted in 6-inch lifts using a vibrating roller.



A cap would be constructed in the middle reach of the Existing Creek Channel and in the Historical Creek Channel Removal Action Area, as portrayed in Figure 14. As described for Alternative 3, prior to capping, geotextile demarcation material would be placed to separate contaminated material from clean cap material. The geotextile demarcation material would be overlain by a 6-inch layer of 4-inch minus rock (Biotic Barrier Layer). The Biotic Barrier Layer would be overlain by geotextile filter fabric, followed by a 2-foot layer of compacted soil. Capped areas would be sloped to drain.

As illustrated in Appendix D (Table D5), under Alternative 4, approximately 794 CY of 4-inch minus rock is required for the Biotic Barrier Layer. The 4-inch minus rock would be imported and stockpiled at the LSC Site at a location that would be determined during the engineering design process. A dump truck would be used to haul the material to the cap areas, and a dozer would be used to spread the material

According to the volume calculations included in Appendix B, a total of 6,976 CY of clean cap material would be needed under this alternative. The material would be loaded into a dump truck and hauled to the capping location, where a loader would spread the cap material, and a vibrating roller would compact the material in 6-inch lifts. The cap would have a 2-foot thickness (compacted) and 3H:1V side slopes (see Figure 11). In the middle reach of the Existing Creek Channel, the full thickness of the cap would extend 5 feet beyond the surveyed creek extent on each side, and in the Historical Creek Channel Removal Action Area, the full thickness would extend 5 feet beyond the "Extent of Historical Creek" on each side. The cap would then slope down at 3H:1V.

Following backfilling of excavated areas, capping, and excavation of the New Upper Creek Channel, disturbed areas would be restored. As in Alternatives 2 and 3, for analysis in this EE/CA, it is estimated that a 3-inch layer of habitat mix (sand/gravel of a particular gradation to be determined) would be placed along the lower reach of the Existing Creek Channel and the New Upper Creek Channel. An estimated 369 CY of habitat mix material would be imported and stockpiled at the LSC Site at a location to be determined during the engineering design process. A dump truck would be used to haul the material to the creek channel, and a dozer would be used to spread the material. As for Alternative 3, following selection of the preferred alternative, engineering design would be employed to identify elements of stream design and restoration that might be necessary as part of the removal action. Such engineering design would evaluate potential impacts to groundwater flow that could result from rerouting the creek. As appropriate, design elements such as a French drain or impermeable barriers could be considered.

This alternative would result in approximately 1 acre of capped area at the LSC Site; the repository area (middle reach of the Existing Creek Channel) would be expanded to hold extra contaminated material excavated from the Historical Creek Channel in order to reroute the creek in that location.



Under Alternative 4, approximately one acre of wetlands would be impacted during construction; the entire acre would be impacted by excavation and fill. This estimate is conservative because uncontaminated wetlands would be avoided to the greatest extent possible during construction. As for Alternatives 2 and 3, impacted wetlands would be restored/mitigated.

Annual PRSC would entail maintenance of the repository and cap areas. These areas would require annual mowing and weeding to ensure that trees were not allowed to grow substantial roots, which could compromise the integrity of the cap if roots were to penetrate the geotextile and the tree subsequently fell, resulting in exposure of soil contained within the root ball. No surface water or groundwater monitoring is expected.

### **Effectiveness**

This alternative would provide a high level of environmental protection and long-term effectiveness, since contaminated material would either be excavated or capped. This alternative would meet the RAOs and ARARs. The onsite potential for human and ecological exposure through inhalation, ingestion, or dermal contact would be eliminated, and contaminant migration via surface runoff or soil or wind erosion would be prevented. Potential impacts to the groundwater flow regime would require further assessment during the engineering design.

In the short term, the impacts to human health and ecological receptors that could occur during construction would include potential exposure to contaminants through fugitive dust emissions and surface water runoff. However, these impacts could be controlled using fencing, institutional controls as described earlier (e.g., warning signs and public education), and BMPs such as use of a water truck and sedimentation ponds.

Implementation of Alternative 4 would have minimal short-term impacts on vehicular traffic, as hauling of contaminated material from the LSC Site would not occur. Vehicular traffic would only occur during mobilization/demobilization of heavy equipment, and during delivery of 4-inch minus rock and habitat mix material to the LSC Site.

# Implementability

The activities associated with this alternative are technically feasible using standard methods and procedures. The necessary equipment, personnel, and services are readily available to support implementation of this alternative. Capping is a widely used remediation method and can be implemented in a relatively short period of time.

This alternative is administratively feasible, and would require the EPA to meet the same ARARs as described for Alternative 3. The removal action areas are the same for Alternatives 2, 3 and 4, and would affect the same acreage of wetlands.



This alternative is expected to be more implementable in terms of COB acceptance since it appears to be more compatible with potential future park plans.

### Cost

The estimated cost to implement this alternative is \$1,457,500 in 2009 dollars. The cost includes direct and indirect capital costs and annual PRSC costs. The cost estimate was developed using the same references and similar assumptions as for Alternatives 2 and 3.

# 7.4.7 Alternative 5: Excavation, Consolidation, Capping, and Long Creek Reroute back through Historical Creek Channel

As for Alternative 4, this alternative would include excavation, consolidation, capping, and creek rerouting back through the Historical Creek Channel; however, under this alternative, the creek would be rerouted to the northeast before connecting to the Historical Creek Channel, and would also be rerouted through the Estuary Area. Alternative 5 would include the following:

- Excavation of an estimated 8,071 CY of contaminated material from the removal action areas—approximately 981 CY from the Existing Creek Channel Removal Action Area and 7,089 CY from the Historical Creek Channel Removal Action Area;
- Placement of 8,071 CY excavated contaminated material within the middle reach of the Existing Creek Channel (repository area) prior to capping;
- Excavation of the New Creek Channel:
- Backfill of excavations using clean material excavated to create the New Creek Channel and from the Estuary Area;
- Capping of the middle and lower reaches of the Existing Creek Channel using clean material excavated to create the New Creek Channel and from the Estuary Area;
- Contamination delineation sampling pre-excavation, and confirmation sampling post-excavation;
- Restoration of the removal action areas, including placement of habitat mix material (sand/gravel of a particular gradation) along the creek channel, revegetation, and wetland restoration/mitigation; and
- Annual PRSC (maintenance of the repository and cap areas).

The cost estimate for Alternative 5, including a list of assumptions, is provided in Appendix D (Table D6). Typical cross sections are provided in Figure 11, and a conceptual design of Alternative 5 is presented in Figure 15. Figure 15 depicts the excavation areas and depths, the repository/cap areas, and the route for the



New Creek Channel. The volume calculations for Alternative 5 are included in Appendix B.

As in Alternatives 2, 3, and 4, prior to excavation and capping of contaminated material the removal action areas would be cleared and grubbed. To better delineate the extent of contamination in the excavation area, soil sampling would be performed. Sampling may occur during rather than before excavation, but for cost estimating purposes, pre-excavation sampling was assumed. Such costs have been estimated based on the following approach. Collection of a total of 310 samples is estimated for onsite screening—at least one sample location for every 625-square-foot area, with an estimated three samples per location. Contamination delineation samples would be analyzed in an onsite trailer for PCP and PAHs using RaPID ® Assay immunoassay test kits, and 20% of the samples would be confirmed by an offsite laboratory. Each of the estimated 62 samples sent to the laboratory for confirmation would be analyzed for PCP by EPA Method 8151, PAHs by EPA Method 8270 SIM, and dioxins/furans by EPA Method 8290. This sampling approach, including numbers and types of samples, was developed for the purpose of analysis in this EE/CA. For EE/CA costing purposes, it was assumed that subsurface soil/sediment sample collection would be performed using a hand auger. An actual sampling approach will be refined as appropriate.

As in Alternatives 3 and 4, the New Creek Channel is assumed to have a cross sectional area of a trapezoid with a side slope of 3H:1V and a bottom width of 5 feet (see Figure 11).

Clean material excavated to create the New Creek Channel would be stockpiled onsite for use as backfill and cap material. Additional clean fill material would be excavated from the Estuary Area. Under Alternative 5, to obtain the estimated 12,934 CY required to backfill and cap removal action areas, an estimated 6,218 CY would need to be excavated from the Estuary Area. Although more backfill/cap material is needed under Alternative 5 than under the other alternatives, more clean fill material is generated under Alternative 5 from construction of the comparatively longer New Creek Channel. As in Alternatives 3 and 4, an onsite construction oversight engineer would field-screen the soil excavated from both the New Creek Channel and the Estuary Area to confirm that it is clean for use as backfill and cap material. In addition to monitoring the soil for visual or olfactory evidence of petroleum contamination, an onsite construction oversight engineer would field-screen the soil using a PID or FID.

Similar to Alternatives 3 and 4, a water diversion system would need to be established for excavation of contaminated soil/sediment from the Existing Creek Channel and Historical Creek Channel, capping in the middle and lower reaches of the Existing Creek Channel, and excavation of the New Creek Channel. Excavated contaminated soil/sediment would be loaded into a dump truck, and placed directly within a repository in the middle reach of the Existing Creek Channel and capped. As in Alternatives 2 through 4, following excavation of the contaminated material volume delineated through pre-excavation onsite



screening, confirmation samples would be collected from the sidewalls of the excavation and the bottom of the excavation for excavated depths less than 6 feet. Additional excavation would be conducted as needed to remove contaminated material that poses a risk to receptors up to a depth of 6 feet. A total of 350 samples is assumed for Alternative 5—one sample every 25 feet along the excavation sidewalls and one sample for every 625-square-foot area for the excavation bottom. Although confirmation sampling at the base of the excavation at a 6-foot depth is not expected, to simplify EE/CA costing, the total excavation area was assumed. An actual sampling approach will be refined as appropriate.

As described for Alternatives 3 and 4, excavated areas would be backfilled with clean material stockpiled from the excavation of the New Creek Channel. Stockpiled clean material would be loaded into a dump truck by a loader, hauled to the areas requiring backfill, and compacted in 6-inch lifts using a vibrating roller.

A cap would be constructed in the middle and lower reaches of the Existing Creek Channel, as portrayed in Figure 15. As described for Alternatives 3 and 4, prior to capping, geotextile demarcation material would be placed to separate contaminated material from clean cap material. The geotextile demarcation material would be overlain by a 6-inch layer of 4-inch minus rock (Biotic Barrier Layer). The Biotic Barrier Layer would be overlain by geotextile filter fabric, followed by a 2-foot layer of compacted soil. Capped areas would be sloped to drain.

As indicated in Appendix D (Table D6), under Alternative 5, approximately 746 CY of 4-inch minus rock is required for the Biotic Barrier Layer. The 4-inch minus rock would be imported and stockpiled at the LSC Site at a location that would be determined during the engineering design process. A dump truck would be used to haul the material to the cap areas, and a dozer would be used to spread the material.

Based on the volume calculations included in Appendix B, a total of 7,566 CY of clean cap material would be needed under this alternative. The material would be loaded into a dump truck and hauled to the capping location, where a loader would spread the cap material, and a vibrating roller would compact the material in 6-inch lifts. The cap would have a 2-foot thickness (compacted) and 3H:1V side slopes (see Figure 11). In the middle reach of the Existing Creek Channel, the full thickness of the cap would extend 5 feet beyond the surveyed creek extent on each side, and in the Historical Creek Channel Removal Action Area, the full thickness would extend 5 feet beyond the "Extent of Historical Creek" on each side. The cap would then slope down at 3H:1V.

Following backfilling of excavated areas, capping, and excavation of the New Creek Channel, disturbed areas would be restored. As in Alternatives 2, 3, and 4, for analysis in this EE/CA, it is estimated that a 3-inch layer of habitat mix (sand/gravel of a particular gradation to be determined) would be placed along the New Creek Channel. An estimated 724 CY of habitat mix material would be

imported and stockpiled at the LSC Site at a location to be determined during the engineering design process. A dump truck would be used to haul the material to the creek channel, and a dozer would be used to spread the material. As for Alternatives 3 and 4, following selection of the preferred alternative, engineering design would be employed to identify elements of stream design and restoration that might be necessary as part of the removal action. Such engineering design would evaluate potential impacts to the groundwater and surface water flow regimes that could result from rerouting the creek. As appropriate, design elements such as a French drain or impermeable barriers could be considered.

Under Alternative 5, it is estimated that approximately 1.5 acres of wetlands would be impacted during construction, including 0.2 acres that would be impacted by capping and 1.3 acres that would be impacted by excavation and fill. This estimate is considered conservative because uncontaminated wetlands would be avoided to the greatest extent possible during construction. As for Alternatives 2, 3, and 4, impacted wetlands would be restored/mitigated.

Annual PRSC would entail maintenance of the repository and cap areas. These areas would require annual mowing and weeding to ensure that trees were not allowed to grow substantial roots, which could compromise the integrity of the cap if roots were to penetrate the geotextile and the tree subsequently fell, resulting in exposure of soil contained within the root ball. As for Alternatives 3 and 4, no surface water or groundwater monitoring is expected.

### **Effectiveness**

This alternative would provide a high level of environmental protection and long-term effectiveness, since contaminated material would either be excavated or capped. This alternative would meet the RAOs and ARARs. The onsite potential for human and ecological exposure through inhalation, ingestion, or dermal contact would be eliminated, and contaminant migration via surface runoff or soil or wind erosion would be prevented. Potential impacts to the groundwater and surface water flow regimes would require further assessment during the engineering design.

In the short term, the impacts to human health and ecological receptors that could occur during construction would include potential exposure to contaminants through fugitive dust emissions and surface water runoff. However, these impacts could be controlled using fencing, institutional controls as described earlier (e.g., warning signs and public education), and BMPs such as use of a water truck and sedimentation ponds.

Implementation of Alternative 5 would have minimal short-term impacts on vehicular traffic because hauling of contaminated material from the LSC Site would not occur. Vehicular traffic would only occur during mobilization/demobilization of heavy equipment, and during delivery of 4-inch minus rock and habitat mix material to the LSC Site.

# Implementability



The activities associated with this alternative are technically feasible using standard methods and procedures. The necessary equipment, personnel, and services are readily available to support implementation of this alternative. Capping is a widely used remediation method and can be implemented in a relatively short period of time.

This alternative is administratively feasible, and would require the EPA to meet the same ARARs as described for Alternatives 3 and 4. The removal action areas are the same for Alternatives 2, 3, and 4. However, approximately 0.5 acre more wetlands would be impacted than estimated for Alternatives 3 and 4 due to the longer creek reroute.

This alternative is expected to be very implementable in terms of COB acceptance since it would be more consistent with the planned park development. There would be less capped area overall, resulting in a smaller area that would require vegetation control. The cap in the lower reach of the Existing Creek Channel is less likely to be inconsistent with COB's plan to elevate that area as part of park redevelopment. The creek would be rerouted to the northeastern portion of the site, connecting the existing surface water hydrologic features in a way that may be compatible with the COB park master plan. Furthermore, the creek would be routed through the estuary area, further contributing to this alternative's compatibility with COB's envisioned park development. As stated above, potential impacts to the groundwater and surface water flow regimes would require further assessment during the engineering design.

### Cost

The estimated cost to implement this alternative is \$1,961,000 in 2009 dollars. The cost includes direct and indirect capital costs and annual PRSC costs. The cost estimate was developed using the same references and similar assumptions as for Alternatives 2, 3, and 4.

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# **Comparative Analysis of Removal Action Alternatives**

A comparative alternative analysis of the removal action alternatives with respect to the effectiveness, implementability, and cost criteria is presented in Table 5 and discussed below.

## **Alternative 1: No Action**

The No Action Alternative would not be effective in eliminating or reducing the threat to human health and ecological receptors.

# Alternative 2: Excavation and Offsite Disposal or Consolidation on the Oeser Property

Excavation and offsite disposal would be a very effective and implementable removal action. However, under each of Options A and B, the costs are significantly higher than costs estimated for Option C, and Alternatives 3, 4, and 5.

A total cost of \$3,342,700 is estimated for Alternative 2, Option A; this cost is nearly two times greater than estimated costs for Alternative 2, Option C, and Alternatives 3, 4, and 5. The higher costs are due primarily to the Subtitle D landfill disposal fees, transportation of contaminated material from the LSC Site to the landfill, and confirmation sampling at the LSC Site to ensure all contaminated material above a 6-foot depth has been removed.

A total cost of \$7,530,400 is estimated for Alternative 2, Option B; this cost is four to seven times greater than costs estimated for Alternative 2, Option C, and Alternatives 3, 4, and 5. The higher costs are due primarily to the comparatively high Subtitle C landfill disposal fees.

The estimated cost for Alternative 2, Option C is \$2,066,200, significantly lower than the costs estimated for Options A and B. The lower cost is due to the lower costs associated with consolidation of contaminated soil/sediment at the Oeser property compared with those for disposal at an offsite facility.

As noted in Section 7.4, it is likely that Alternative 2, if implemented, would consist of some combination of the three options, rather than solely Option A, B, or C. The actual combination of Alternative 2 would depend on how much of the contaminated material is hazardous and on limits on the capacity for contaminated material consolidation at the Oeser facility. The costs for each option were

# 8. Comparative Analysis of Removal Action Alternatives

estimated individually to assess the possible range of costs under Alternative 2. The estimated cost for each option under this alternative is greater than the estimated costs for Alternatives 3, 4, and 5. Excavation and consolidation in a repository at the Oeser facility would be very effective at a more reasonable cost than for Options A and B, but could potentially be less implementable than other alternatives depending on actual contaminated soil volumes due to height restrictions for site operations and other property characteristics would limit the height of the repository, and therefore the volume of contaminated material that could be consolidated at the Oeser property.

# Alternative 3: Excavation, Consolidation, Capping, and Creek Reroute

Excavation, consolidation, capping, and creek rerouting would be an effective removal action at a comparatively low cost. The total estimated cost of \$1,150,100 is considerably lower than costs estimated for Alternative 2, Options A and B, and 57% lower than that for Alternative 2, Option C. Approximately 1.5 acres of the LSC Site would be capped. Capped areas would require planting restrictions. Representatives of COB have indicated that this alternative would not be preferable because it may restrict possible future development of Little Squalicum Park. Specific concerns include potential incompatibility between the hydrology resulting from the remedy and that envisioned in the park Master Plan (COB 2010), restrictions of planting in capped areas, and reduction of active use area with a centrally located creek channel.

# Alternative 4: Excavation, Consolidation, Capping and Creek Reroute back through Historical Creek Channel

This alternative would be similar to Alternative 3, except that the creek would be rerouted back through the Historical Creek Channel, rather than rerouted into an entirely new channel through the center of the LSC Site. Effectiveness would be similar to that of Alternative 3.

The total estimated cost of \$1,457,500 is considerably lower than costs estimated for Alternative 2, Options A and B, 35% lower than those for Alternative 2, Option C, and 24% higher than those for Alternative 3. The difference in cost between Alternatives 3 and 4 is due primarily to the extra earthwork required under Alternative 4 for the additional excavation of contaminated material for placement within the repository (middle reach of the Existing Creek Channel), and on the additional analytical testing (onsite field screening and offsite laboratory confirmation testing) associated with a greater area of contaminated material excavation.

In addition to a reasonable cost, Alternative 4 may be more compatible with possible future land development, since there would be less capped area, and the creek channel would be rerouted back through the Historical Creek Channel, connecting the existing hydrology in that area, and allowing more active use area for park development.



# Alternative 5: Excavation, Consolidation, Capping and Long Creek Reroute back through Historical Creek Channel

This alternative would be similar to Alternative 4, except that the creek would be rerouted to the northeastern portion of the Site and back through the Historical Creek Channel, connecting the existing hydrology as envisioned in the COB park plan. The creek would also be routed through the Estuary Area, further contributing to the possible compatibility with the COB's park redevelopment plan. Effectiveness would be similar to that of Alternatives 3 and 4.

This alternative would result in approximately 1 acre of capped area at the LSC Site; the repository area (middle reach of the Existing Creek Channel) would be expanded to hold extra contaminated material excavated from the Historical Creek Channel in order to reroute the creek through the lower portion, and allow unrestricted planting in the upper portion.

The total estimated cost of \$1,961,000 is considerably lower than costs estimated for Alternative 2, Options A and B, 5% lower than those for Alternative 2, Option C, 52% higher than those for Alternative 3, and 29% higher than those for Alternative 4. The difference in cost between Alternatives 4 and 5 are due primarily to the extra earthwork required under Alternative 5 for the excavation of the longer creek channel (and associated wetland impact costs), additional excavation of contaminated material for placement within the repository (middle reach of the Existing Creek Channel), and the additional analytical testing (onsite field screening and offsite laboratory confirmation testing) associated with a greater area of contaminated material excavation.

Although the cost to implement Alternative 5 would be approximately 29% higher than those estimated under Alternative 4, this alternative appears to be more compatible with possible future park development, since there would be less capped area overall, allowing less restricted plant growth, and the cap in the lower reach of the Existing Creek Channel would be compatible with COB's plan to elevate that area as part of park redevelopment. The creek would be rerouted to the northeastern portion of the site, connecting the existing hydrologic features as envisioned in the COB park plan. The creek would also be routed through the estuary envisioned in the COB park plan, further contributing to the COB's park redevelopment objectives.

Futhermore, with the implementation of this alternative, there may be an opportunity for Oeser to work with the COB to perform more work as envisioned in the COB's park plan. Development of the Estuary Area could potentially contribute to fulfillment of wetland mitigation requirements. Additional material excavated from the Estuary Area could potentially be placed over the Existing Creek Channel lower and middle reach cap areas, which would elevate the lower reach area as envisioned in the COB park plan, and potentially allow for unrestricted plant growth in those areas if enough material is emplaced.



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# Recommended Removal Action Alternative

# 9.1 Description of Evaluation Process Used to Develop Recommended Action

As directed in the EPA document *Guidance on Conducting Non–Time-Critical Removal Actions under CERCLA* (EPA 1993), the removal action alternatives presented in this EE/CA have been evaluated against three general criteria: effectiveness, implementability, and cost. The specific components of each criterion, as described in Section 7.1, were considered.

## 9.2 Recommended Removal Action

Based on evaluation of the alternatives according to the criteria of effectiveness, implementability, and cost, the recommended removal action is Alternative 3.

Completion of a removal action under Alternative 3 would effectively eliminate the potential for human or ecological exposure through inhalation, ingestion, or dermal contact, and prevent contaminant migration via surface runoff or soil or wind erosion. The actions are technically feasible using standard methods and procedures, and costs would be relatively low. It's possible that the issues that the COB has identified could be resolved upon further review.

Alternative 2, Options A and B are considered unnecessarily costly, approximately 3 and 6 times more than Alternative 3. Alternative 2, Option C, although less costly than Options A and B, may not be technically implementable due to operational restrictions at the Oeser facility that would limit the amount of contaminated material that could be consolidated there.

Alternatives 4 and 5 are viable alternatives and would be equally effective. Costs for these alternatives are somewhat greater than for Alternative 3 (27% and 71%, respectively).

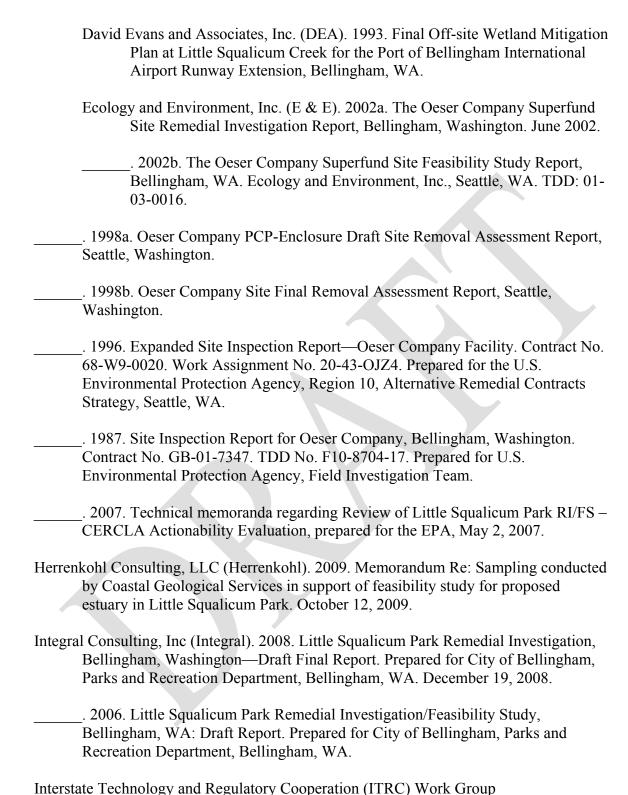
Stakeholder and community acceptance of these alternatives will be assessed based on review of comments on this EE/CA. The EPA may also consider development of a new removal action alternative that incorporates elements of Alternatives 2, 3, 4 and/or 5.



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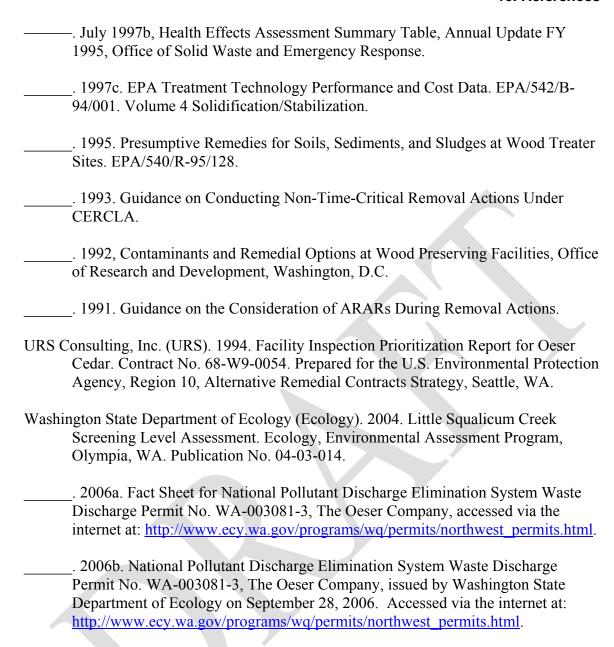
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# 11 Tables



	· ·		and Ecological Risk Screening Levels for Soil/Sedin			
Chemical	Risk Type	Media	Screening Benchmark	Value	Units	Remarks
			EPA Regional Screening Level - Residential  MTCA Method B Direct Contact	3 8.3	mg/kg mg/kg	Direct contact pathway (not leaching to groundwater).  From Integral (2006, Table F-25); unrestricted land use. Direct contact (not leaching to groundwater).
			MTCA Method B Direct Contact	0.3	mg/kg	Back-calculated by Integral (and provided in their review comments) from parameters and equations in Oeser
						Company Site RI assuming adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours
			Recreational Use Screening Value, 10-6 cancer risk	50		per visit. Fractional soil contact not considered.
	Human Health	Soil	Oeser ROD Cleanup Level	120	mg/kg	Based on industrial worker scenario for 1.0E-5 cancer risk.  Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming adolescent (8-
			Recreational Use Screening Value, 10-6 cancer risk	224.7	mg/kg	18 years old) visiting the park 2 days per week year round, 4 hours per visit.
			Recreational Use Screening Value, 10-4 cancer risk	5,000	mg/kg	Recreational Use Screening Value (10-6 cancer risk) calculated by Integral multiplied by 100. Fractional soil contact not considered.
			Recreational Use Scieering Value, 10-4 cancer risk	5,000	Hig/kg	Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming adolescent (8-
			Recreational Use Screening Value, 10-4 cancer risk	22,474	mg/kg	18 years old) visiting the park 2 days per week year round, 4 hours per visit.
			Ecological Indicator Soil Concentration for Plant Protection	3	mg/kg	MTCA Table 749-3; based on Efroymson et al. (1997a).
			ORNL Phytotoxicity Benchmark	3	mg/kg	Efroymson et al. (1997a).
Pentachlorophenol			Shrew Soil Benchmark (HQ-LOAEL = 1)	3.3	mg/kg	Back-calculated from shrew exposure parameters and PCP mammalian LOAEL from Oeser Company Site RI report such that HQ = 1.
		Soil	Ecological Indicator Soil Concentration for Wildlife Protection	4.5	mg/kg	MTCA Table 749-3.
			Ecological Indicator Soil Concentration for Soil Biota Protection	6	mg/kg	MTCA Table 749-3. Based on Efroymson et al. (1997b).
			ORNL Earthworm Benchmark	6	mg/kg	Efroymson et al (1997b).
	Facilitation		Robin Soil Benchmark (HQ-LOAEL = 1)	67	mg/kg	Back-calculated from robin exposure parameters from Oeser Company Site RI report and PCP avian LOAEL such that HQ=1. PCP avian LOAEL of 67.3 mg/kg-day from Stedman et al. (1980).
	Ecological		Washington State Marine Sediment Quality Standard (SQS)	0.36	mg/kg	WAC 173-204-320 Table I. No freshwater sediment benchmark available.
					9.19	
						WAC 173-204-520 Table III. No freshwater sediment value available. This value is recommended by E&E as the
		Sediment	Washington State Marine Cleanup Sceening Level			cleanup level for PCP for the protection of ecological receptors. This value is less than all PCP screening values for soil and sediment compiled by E&E for protection of ecological receptors, except one. Only the Washington State
		Sediment	(CSL)/Recommended Potential Remediation Goal (PRG) for Protection			SQS for PCP (0.36 mg/kg) is lower. However, because the subject of the EE/CA is remediation, not assessment,
			of Ecological Receptors	0.69	mg/kg	the CSL is the more appropriate value for developing cleanup plans and costs.
			Swallow Sediment Benchmark (HQ-LOAEL = 1)	39	mg/kg	Back-calculated from swallow exposure parameters from Oeser Company Site RI report and PCP avain LOAEL
			EDA Degianal Careening Layel Degidential	0.015	20 m/l m	such that HQ = 1. PCP avian LOAEL of 67.3 mg/kg-day from Stedman et al. (1980).
			EPA Regional Screening Level - Residential  MTCA Method B Direct Contact	0.015	mg/kg mg/kg	Direct contact pathway (not leaching to groundwater).  From Integral (2006, Table F-25); unrestricted land use. Direct contact (not leaching to groundwater).
			INTO T Method B Billott Gontact	0.107	mg/kg	As BaP TEQ. Back-calculated by Integral (and provided in their review comments) from parameters and equations
						in Oeser Company Site RI assuming adolescent (8-18 years old) visiting the park 2 days per week year round, 4
			Recreational Use Screening Value, 10-6 cancer risk	1.1	mg/kg	hours per visit. Fractional soil contact not considered.  As BaP TEQ. Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming
			Recreational Use Screening Value, 10-6 cancer risk	4.5	mg/kg	adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours per visit.
Carcinogenic PAHs <sup>2</sup>	Human Health	Soil	Oeser ROD Cleanup Level	8.9	mg/kg	Based on industrial worker scenario for 1.0E-5 cancer risk.
Oardinogenie i Ai is			B	440		Recreational Use Screening Value (10-6 cancer risk) calculated by Integral multiplied by 100. Fractional soil
			Recreational Use Screening Value, 10-4 cancer risk	110	mg/kg	contact not considered.  As BaP TEQ. Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming
			Recreational Use Screening Value, 10-4 cancer risk	453	mg/kg	adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours per visit.
			*			90th percentile of 22 background samples collected as part of the Oeser Company Site RI. This value is
			Background Soil Concentration	0.37	mg/kg	recommended by E&E as the cleanup level for carcinogenic PAHs. Although the MTCA Method B DIrect
						Contact screening level is lower, the use of a cleanup level less than background is not practical. The 90th percentile was selected as the appropriate background statistic based on MTCA 173-340-709.
			Ecological Indicator Soil Concentration for BaP, Wildlife Protection	12	mg/kg	MTCA Table 749-3.
			Shrew Soil Benchmark (HQ-LOAEL = 1)	13.6	mg/kg	Back-calculated from shrew exposure parameters and benzo(a)pyrene mammalian LOAEL from Oeser Company
			,			Site RI report such that HQ = 1.
		Soil	ORNL Phytotoxicity Benchmark for Acenaphthalene	20		Efroymson et al. (1997a) and MTCA Table 749-3.
			ORNL Earthworm Benchmark for Fluorene.	30	mg/kg	Efroymson et al. (1997b) and MTCA Table 749-3.
			Robin Soil Benchmark (HQ-LOAEL = 1)	408	mg/kg	Back-calculated from robin exposure parameters and total PAH avian LOAEL from Oeser Company Site RI report such that HQ = 1.
Total PAHs <sup>3</sup>	Ecological	Cadimant	Theshold Effects Concentration (TEC)	1.6	mg/kg	MacDonald et al. (2000). For benthic invertebrates. Dry weight basis.
		Sediment	Probable Effects Concentration (PEC)	22.8	mg/kg	MacDonald et al. (2000). For benthic invertebrates. Dry weight basis.
						90th percentile of 22 background samples collected as part of the Oeser Company Site RI. This value is
						recommended by E&E as the cleanup level for total PAHs for the protection of ecological receptors. This value is less than all screening values for soil and sediment compiled by E&E for protection of ecological receptors,
		Soil	Background Soil Concentration/Recommended PRG for Protection of	3.6	mg/kg	except one. Only the threshold effect concentration (TEC, 1.6 mg/kg total PAHs) from MacDonald et al.
			Ecological Receptors			(2000) is lower. Use of a cleanup level less than background is not practical; therefore, background was
						selected as the cleanup level for total PAHs. The 90th percentile was selected as the appropriate background statistic based on MTCA 173-340-709.
			EPA Regional Screening Level - Residential	4.5E-06	mg/kg	For 2,3,7,8-TCDD. Direct contact pathway (not leaching to groundwater).
			MTCA Method B Direct Contact	1.1E-05	mg/kg	MTCA Method B, carcinogen, direct contact (ingestion only), unrestricted land use.
						As TCDD TEQ. Back-calculated by Integral (and provided in their review comments) from parameters and
			Recreational Use Screening Value, 10-6 cancer risk	6.3E-05	mg/kg	equations in Oeser Company Site RI assuming adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours per visit. Fractional soil contact not considered.
	Human Health	Soil	reorealional obo coronling value, 10 o cancer link	0.02 00	mg/kg	As TCDD TEQ. Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming
	numan neam	5011	Recreational Use Screening Value, 10-6 cancer risk	2.7E-04	mg/kg	adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours per visit.
			Oeser ROD Cleanup Level	8.8E-04	mg/kg	MTCA Method C for industrial soils.  Recreational Use Screening Value (10-6 cancer risk) calculated by Integral multiplied by 100. Fractional soil
			Recreational Use Screening Value, 10-4 cancer risk	6.3E-03	mg/kg	contact not considered.
					- 0 0	As TCDD TEQ. Back-calculated by E&E from parameters and equations in Oeser Company Site RI assuming
			Recreational Use Screening Value, 10-4 cancer risk	2.7E-02	mg/kg	adolescent (8-18 years old) visiting the park 2 days per week year round, 4 hours per visit.
			Ecological Indicator Soil Concentration, Wildlife Protection	2.0E-06	mg/kg	MTCA Table 749-3.
Dioxins/Furans			Shrew Soil Benchmark (HQ-LOAEL = 1)	2.5E-05	mg/kg	Back-calculated from shrew exposure parameters and 2,3,7,8-TCDD mammalian LOAEL from Oeser Company Site RI report such that HQ = 1.
		Soil		_		Back-calculated from robin exposure parameters and 2,3,7,8-TCDD avain LOAELfrom Oeser Company Site RI
			Robin Soil Benchmark (HQ-LOAEL = 1)	1.4E-04	mg/kg	report such that HQ = 1.
			Earthworm Benchmark.	0.5	mg/kg	USEPA (1999). Toxicity value for 2,3,7,8-TCDD.
			NOAA SQUIRT Benchmark.	4.30E-05	mg/kg	From Buchman (1999) adjusted to 4.9% TOC (average for sediment samples in LSP database).
	Ecological	Sediment	Swallow Sediment Benchmark (HQ-LOAEL =1)	4.32E-04	mg/kg	Back-calculated from swallow exposure parameters and 2,3,7,8 TCDD avain LOAEL from Oeser Company Site RI
		<b></b>			_	report such that HQ =1.  90th percentile of 20 background soil samples collected as part of the Oeser Company Site RI. This value is
						recommended by E&E as the cleanup level for dioxins/furans for the protection of ecological receptors. This
			Background Soil Concentration/Recommended PRG for Protection of			value is less than all screening values for soil and sediment compiled by E&E for protection of ecological
		Soil	Ecological Receptors	1.2E-05	mg/kg	receptors, except one. Only the MTCA Ecological Indicator Soil Concentration for wildlife (2.0E-6 mg/kg) is
						less than this value. Use of a cleanup level less than background is not practical; therefore, background was selected as the cleanup level for dioxins/furans. The 90th percentile was selected as the appropriate
		<u> </u>		<u> </u>	<u> </u>	background statistic based on MTCA 173-340-709.
Notes:		-				

# Notes:

- ${\bf 1. \ Soil \ and \ sediment \ were \ considered \ together \ as \ one \ exposure \ medium \ for \ the \ following \ reasons:}$ 
  - a. The LSP ravine includes seasonally flooded wetland habitat. As such, the boundary between soil and sediment is indistinct in some parts of the park.
- b. The channel of Little Squalicum Creek will likely be realigned, and according to the City of Bellingham, additional wetlands may be created. As such, conversion of terrestrial to wetland/aquatic habitat and visa versa within LSP is highly likely.

  2. Sufficient toxicological data is available to derive a slope factor (measure of the compound's cancer potency) for benzo(a) pyrene but not for any of the other carcinogenic PAHs (cPAHs). EPA recommends that a toxicity equivalency factor (TEF) be used to convert concentrations of cPAHs to an equivalent concentration of benzo(a)pyrene when assessing the risks posed by these substances. These TEFs are based on the potency of each compound relative to that of benzo(a)pyrene. cPAHs are evaluated as a single group of compounds (rather than individual compounds) because there has been demonstrated additivity between the toxicity of the individual compounds (USEPA 1993).
- 3. PAHs occur in the environment in a variety of mixtures and act jointly under a common mode of action in affecting ecological receptors (Swartz et al. 1995, USEPA 2003, USEPA 2007). for soil/sediment rather than multiple values for individual PAH compounds. Therefore, a value for total PAHs is being considered as a remedial goal

# Key:

BaP = Benzo(a)pyrene CSL = cleanup screening level EE/CA = Engineering Evaluation/Cost Analysis E&E = Ecology and Environment, Inc. EPA = (U.S.) Environmental Protection Agency

HQ = hazard quotient

HQ-LOAEL = hazard quotient based on lowest observed adverse effects level LOAEL = lowest observed adverse effects level LSP = Little Squalicum Park

MCL = maximum contaminant level MTCA = Model Toxics Control Act

NAWQC = National Ambient Water Quality Criteria

NOAA = National Oceanic and Atmospheric Adminstration

ORNL = Oak Ridge National Laboratory

PCP = Pentachlorophenol

PAH = polycyclic aromatic hydrocarbon PQL = practical quantitation limit PRG = Potential remediation goal

RBC = Risk based concentration RI = Remedial Investigation ROD = Record of Decision

SQUIRT = Screening Quick Reference Tables SQS = sediment quality standard TCDD = Tetrachlorodibenzo-p-dioxin TEQ = toxic equivalent (concentration) TOC = total organic carbon

TRV = toxicity reference value

USEPA = United States Environmental Protection Agency

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Engineering Evaluation/Cost Analysis Little Squalicum Creek, Bellingham, Washington

### Table 2: Calculation of Site-Specific Cleanup Levels for Recreational User, Little Squalicum Creek, Bellingham, Washington

Scenario Timeframe: Current/Future

Exposure Point: Upper Creek Medium: Surface Soil

Exposure Medium: Surface Soil

Receptor Population: Recreational User

Receptor Age: Adolescent

Exposure	Chemical of Potential							
Route	Concern	Max Value	Units	RME Intake	CDI/Cs	Units	Slope Factor	RM Risk
Dermal	cPAHs	172.08	mg/kg	1.28E-06	7.42E-09	mg/kg-day	7.30E+00	9.33E-06
Dermal	TCDD TEQ	0.00137	mg/kg	2.35E-12	1.71E-09	mg/kg-day	1.50E+05	3.52E-07
Dermal	Pentachlorophenol	1.8	mg/kg	2.57E-08	1.43E-08	mg/kg-day	1.20E-01	3.08E-09
Subtotal								9.68E-06
Ingestion	cPAHs	172.08		3.92E-06	2.28E-08	mg/kg-day	7.30E+00	2.86E-05
Ingestion	TCDD TEQ	0.00137	mg/kg	3.12E-11	2.28E-08	mg/kg-day	1.50E+05	4.69E-06
Ingestion	Pentachlorophenol	1.8	mg/kg	4.10E-08	2.28E-08	mg/kg-day	1.20E-01	4.92E-09
Subtotal								3.33E-05
Inhalation	cPAHs	172.08	mg/kg	3.74E-10	2.18E-12	mg/kg-day	3.10E+00	1.16E-09
Inhalation	Dioxin TEQ	0.00137	mg/kg	2.98E-15	2.18E-12	mg/kg-day	1.50E+05	4.47E-10
Inhalation	Pentachlorophenol	1.8	mg/kg	3.92E-12	2.18E-12	mg/kg-day	1.80E-02	7.05E-14
Subtotal								1.61E-09
Total								4.3E-05

Exposure Route	Chemical of Potential Concern	General Intake Factor	Pathway- specific Intake Factor	ABS	Slope Factor	Combined pathway-specific intake factors	CUL (mg/kg)
							(
Dermal	cPAHs	4.38E+03	2.37E+02	0.13	7.30		
Dermal	TCDD TEQ	4.38E+03	1.13E+06	0.03	1.50E+05		
Dermal	Pentachlorophenol	4.38E+03	7.50E+00	0.25	0.12		
Ingestion	cPAHs	4.38E+03	7.30E+02	NA	7.30		
Ingestion	TCDD TEQ	4.38E+03	1.50E+07	NA	1.50E+05		
Ingestion	Pentachlorophenol	4.38E+03	1.20E+01	NA	0.12		
Combined	cPAHs	4.38E+03				9.67.E+02	4.5
Combined	TCDD TEQ	4.38E+03				1.61.E+07	2.7E-04
Combined	Pentachlorophenol	4.38E+03				1.95.E+01	224

General intake factor = (Target risk \* BW \* AT \* CF)/(EF \* ED \* FC)

where:

Target risk = 1E-06

BW = 49 kg

AT = 25,550 d (for carcinogens)

CF = 1E+6 mg/kgEF = 104 d/yr

ED = 11 y

FC = 0.25

Ingestion pathway-specific intake factor = IR \* SF

where:

IR = 100 mg/d

SF = chem-specific

Dermal pathway-specific intake factor = SA \* EV \* AF \* ABS \* SF

where:

SA = 2,500 cm2

EV = 1 events/d

AF = 0.1 mg/cm2

ABS = chem-specific

SF = chem-specific

CUL = general intake factor / combined pathway-specific intake factors

### Note on Cancer Slope Factor:

Oral slope factors were used in the calculation of cleanup levels.

The HHRA included the use of modified oral slope factors for the dermal pathway for TCDD TEQs, PCP, and cPAHs.

Integral's CUL calculations were based on the use of the dermal slope factors, consistent with the HHRA.

However, recent EPA dermal risk assesment guidance (RAGS E 2004) indicates that oral slope factors should NOT be modified for TCDD, cPAHs, or PCP.

To be consistent with the most recent EPA dermal risk assessment guidance, unmodified oral slope factors were used in the calculation of

No other changes were made in assumptions for the recreational scenario.

**Table 3. Proposed Cleanup Levels for Protection of Ecological Receptors** 

Chemical	PRG	Value (mg/kg)	Rationale
PCP	Washington State Cleanup Screening Level (CSL) for Marine Sediment	0.69	From WAC 173-204-520. Less than all PCP screening values for soil and sediment compiled by E & E for protection of ecological receptors, except one. Only the Washington State SQS for PCP (0.36 mg/kg) is lower. However, because the subject of the EE/CA is remediation, not assessment, the CSL is the more appropriate value for developing cleanup plans and costs.
TPAHs	Background soil concentration	3.6	90 <sup>th</sup> percentile of 22 background soil samples collected from Bellingham as part of the Oeser RI (E & E 2002). This value is less than all screening values for soil and sediment compiled by E & E for protection of ecological receptors, except one. Only the threshold effect concentration for TPAHs (1.6 mg/kg; MacDonald <i>et al.</i> 2000) is lower. Use of a cleanup level less than background is not practical; therefore, background was selected as the cleanup level for TPAHs. The 90 <sup>th</sup> percentile was selected as the appropriate background statistic based on WAC 173-340-709.
Dioxins/furans	Background soil concentration	1.2E-5	90 <sup>th</sup> percentile of 20 background soil samples collected from Bellingham as part of the Oeser RI. This value is less than all screening values for soil and sediment compiled by E & E for protection of ecological receptors, except one; only the MTCA Ecological Indicator Soil Concentration for wildlife (2.0E-6 mg/kg) is less than this value. Use of a cleanup level less than background is not practical; therefore, background was selected as the cleanup level for dioxins/furans. The 90 <sup>th</sup> percentile was selected as the appropriate background statistic based on WAC 173-340-709.

## Key:

CSL = cleanup screening level

E & E = Ecology and Environment, Inc.

EE/CA = Engineering Evaluation/Cost Analysis

mg/kg = milligrams per kilogram MTCA = Model Toxics Control Act PCP = pentachlorophenol

RI = Remedial Investigation SQS = Sediment Quality Standard

TPAHs = total polycyclic aromatic hydrocarbons WAC = Washington Administrative Code

### References:

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**Table 4: Potential Applicable or Relevant and Appropriate Requirements** 

Standard, Requirement, Criterion, or Limitation	or Relevant and Appropriate Requirements  Citation	Description	ARAR
Chemical-Specific	Station	Bescription	ARAR
Federal .			
Resource Conservation and Recovery Act (RCRA), Identification and Management of Hazardous Wastes	40 CFR 261 et seq.	Specifies how to determine whether a solid waste is considered hazardous (whether listed or based on characteristic) and how to manage hazardous wastes.	Relevant and appropriate (state is authorized for RCRA)
United States Environmental Protection Agency (EPA) Regional Screening Levels (RSLs)	EPA RSL Table http://www.epa.gov/reg3hwmd/risk/human/rb- concentration_table/index.htm	Provides regional screening levels for chemical contaminants at Superfund sites.	To be considered
EPA Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities	EPA. 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft. EPA530- D-99-001A.	Provides a screening level ecological risk assessment protocol to evaluate potential risk posed by atmospheric emissions to local ecological receptors in the vicinity of combustion facilities.	To be considered
EPA Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures.	EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. Office of Research and Development. Washington, DC 20460.	Presents an approach for developing a site- specific sediment benchmark for total PAHs for protection of aquatic organisms.	To be considered
EPA Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons	EPA. 2007. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons, Interim Final, Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-78.	Provides soil screening levels for PAHs.	To be considered
National Oceanic and Atmospheric Administration (NOAA) Quick Screening Values	Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration.	Provides criteria for protection of ecological receptors.	To be considered
Washington State			
Model Toxics Control Act (MTCA), Cleanup Standards	WAC 173-340-700 through 173-340-760	Provides standards for cleanup of contamination in soils, surface water and groundwater.	Applicable
Sediment Management Standards (SMS)	WAC 173-204	Provides standards for cleanup of contamination in sediment—includes marine sediment standards; freshwater sediment standards are reserved under WAC 173-204-340 for the Department of Ecology to determine on a case-by-case basis.	Applicable
Freshwater Sediment Quality Values	Washington Department of Ecology. 2003.  Development of Freshwater Sediment Quality Values for Use in Washington State, Publication No. 03-09-088, prepared by Avocet Consulting,	Provides freshwater sediment quality values as guidelines—not meant to replace bioassays as the definitive determination of sediment toxicity.	To be considered

**Table 4: Potential Applicable or Relevant and Appropriate Requirements** 

Standard, Requirement, Criterion, or Limitation	or Relevant and Appropriate Requirement	Description	ARAR
	Kenmore, WA.		
Other			
Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems	MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.	Provides consensus-based sediment quality guidelines for 28 chemicals of concern.	To be considered
Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants	Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. ORNL, Oak Ridge, TN. ES/ER/TM-85/R3.	Provides criteria for protection of ecological receptors.	To be considered
Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes	Efroymson, R.A., M.E. Will, G.W. Suter. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes. ORNL, Oak Ridge, TN. ES/ER/TM-126/R2.	Provides criteria for protection of ecological receptors.	To be considered
Location-Specific			
Federal			
Endangered Species Act	16 USC 1531 et seq. 50 CFR 402	Requires action to conserve endangered species and critical habitat.	Applicable
Fish and Wildlife Coordination Act	16 USC 661 et seq. 40 CFR 6.302	Requires coordination with Federal and State agencies to provide protection of fish and wildlife.	Applicable
Native American Graves Protection and Repatriation Act	25 USC 3001 et seq. 43 CFR 10	Regulations that pertain to the identification, protection and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony.	Applicable
Clean Water Act (CWA), Section 401 and 404	33 USC 1344 40 CFR 230 33 CFR 320-330	Restricts discharge of dredged or fill material into surface waters, including wetlands. If wetlands are disturbed, the disturbance should comply with the substantive requirements of the U.S. Army Corps of Engineers Nationwide Permit 38.	Applicable
Washington State			
MTCA, Site Cleanup and Monitoring	WAC 173-340-400 through 173-340-440	Provides requirements for implementation of the cleanup action, compliance monitoring, periodic review, interim action and institutional controls.	Applicable
Action-Specific			
Federal			
Clean Air Act (CAA), National Ambient Air Quality Standards	42 USC 7401 et seq. 40 CFR 50	Provides air quality standards for six criteria pollutants, including particulate matter, to protect public health and welfare.	Applicable
CWA, National Pollutant Discharge	40 CFR 122-125	Establishes discharge limits and monitoring	Applicable

**Table 4: Potential Applicable or Relevant and Appropriate Requirements** 

Standard, Requirement, Criterion, or Limitation	Citation	Description	ARAR
Elimination System (NPDES)	Onaon	requirements for direct discharges to surface	7.IV.IX
Permitting Program \		waters.	
RCRA, Corrective Action Management Unit (CAMU)	40 CFR 264.552	Specifies requirements for use of a CAMU. A CAMU is an area within a facility that is used only for managing CAMU-eligible wastes for implementing corrective action or cleanup at the facility. A CAMU must be located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originated.	Applicable (if a CAMU is used).
RCRA, Land Disposal Restrictions	40 CFR 268	Regulates the disposal of hazardous waste on land without prior treatment.	Applicable (if soil determined to be hazardous and a land disposal unit is included in the cleanup action).
RCRA, Hazardous Waste	Not codified; EPA. 1998. Management of	Specifies how to determine whether contaminated	To be considered
Management, Contained-In Policy for	Remediation Waste Under RCRA (EPA530-F-98-	environmental media (such as soil) contains	
Contaminated Environmental Media, Area of Contamination Policy	026, October 1998).	hazardous waste, and how RCRA regulations apply to the movement of contaminated media.	
RCRA, Hazardous Waste Management	40 CFR Part 261 et seq.	Specifies how to manage hazardous waste and contaminated media	Relevant and appropriate
Hazardous Materials Transportation Act	49 USC 1801-1813 49 CFR 107, 171-177	Regulates the transportation of hazardous waste.	Applicable (if offsite disposal included in cleanup action).
Ecological Revitalization of Superfund Sites	EPA Fact Sheet, EPA 542-F-06-002, December 2006	Addresses the revitalization and revegetation of Superfund Sites	To be considered
Land Use in the CERCLA Remedy Selection Process	EPA Policy, OSWER Directive No. 9355.7-04, May 1995	Addresses consideration of future land use in cleanup decisions	To be considered
Washington State			
Ambient Air Quality Standards for Particulate Matter	WAC 173-470	Establishes maximum acceptable levels for particulate matter in the ambient air.	Applicable
Dangerous Waste Regulations	WAC 173-303	Regulates the handling and disposal of solid waste considered to be dangerous to public health or the environment.	Applicable
Solid Waste Handling Standards	WAC 173-350	Regulates the handling and disposal of solid waste.	Applicable

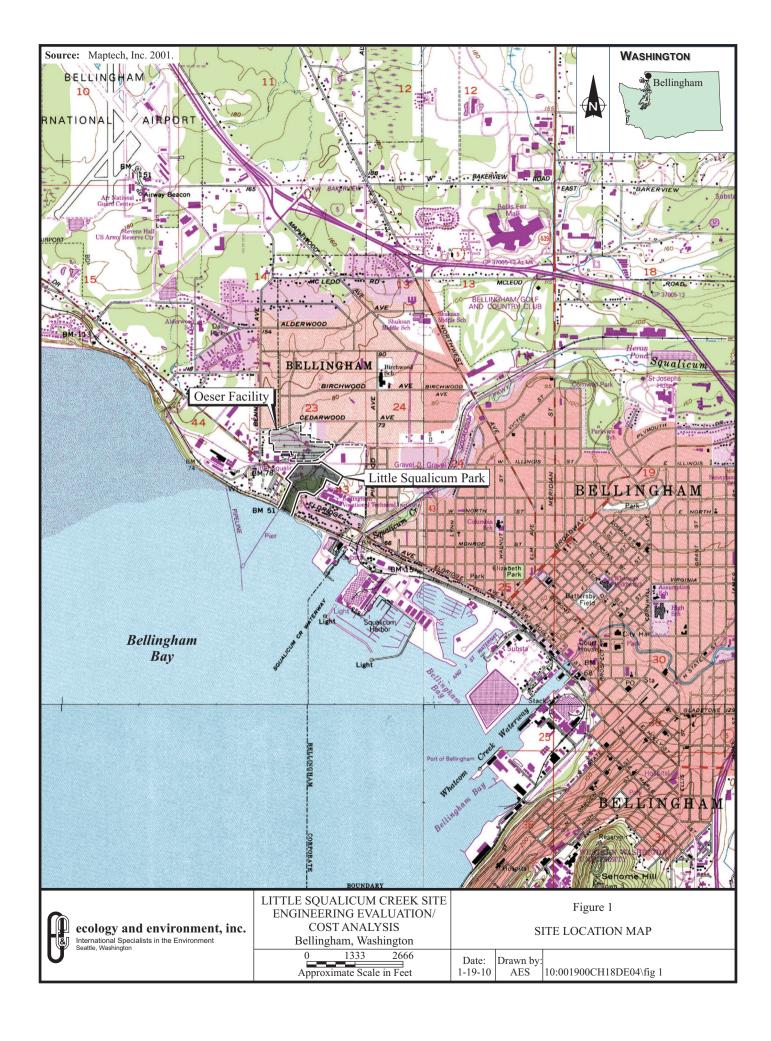
Key:					
ARAR	=	Applicable or Relevant and Appropriate Requirement	NPDES	=	National Pollution Discharge Elimination System
CAMU	=	Corrective Action Management Unit	PAH	=	polycyclic aromatic hydrocarbon
CFR	=	Code of Federal Regulations	PRG	=	Preliminary Remediation Goal
CAA	=	Clean Air Act	RCRA	=	Resource Conservation and Recovery Act
CWA	=	Clean Water Act	RCW	=	Revised Code of Washington
EPA	=	United States Environmental Protection Agency	RSL	=	Regional Screening Level
MTCA	=	Model Toxics Control Act	SMS	=	Sediment Management Standards
NCP	=	National Oil and Hazardous Substances Pollution Contingency Plan	USC	=	United States Code
NOAA	_	National Oceanic and Atmospheric Administration	WAC	_	Washington Administrative Code

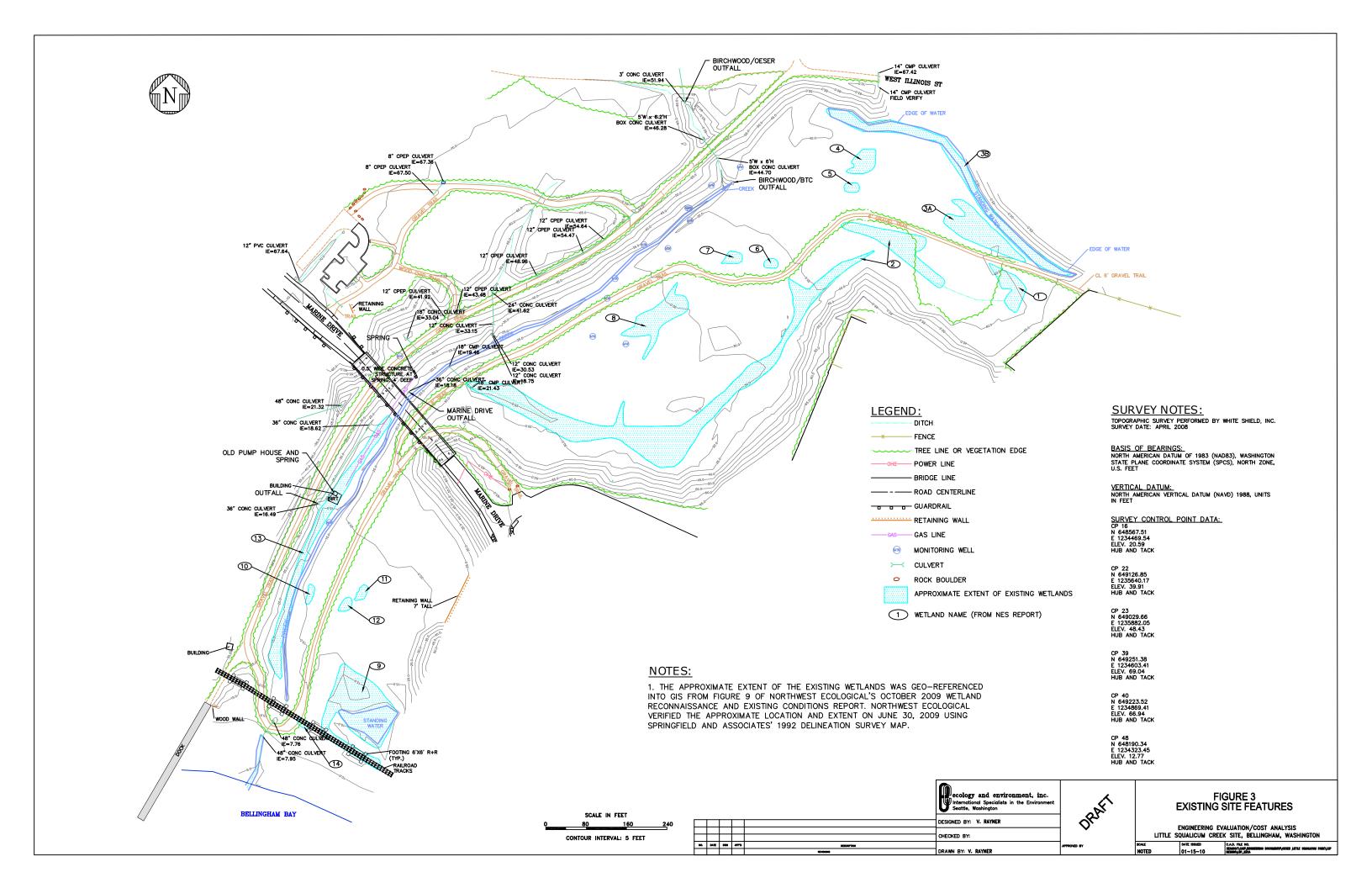
**Table 5: Comparative Alternative Analysis** 

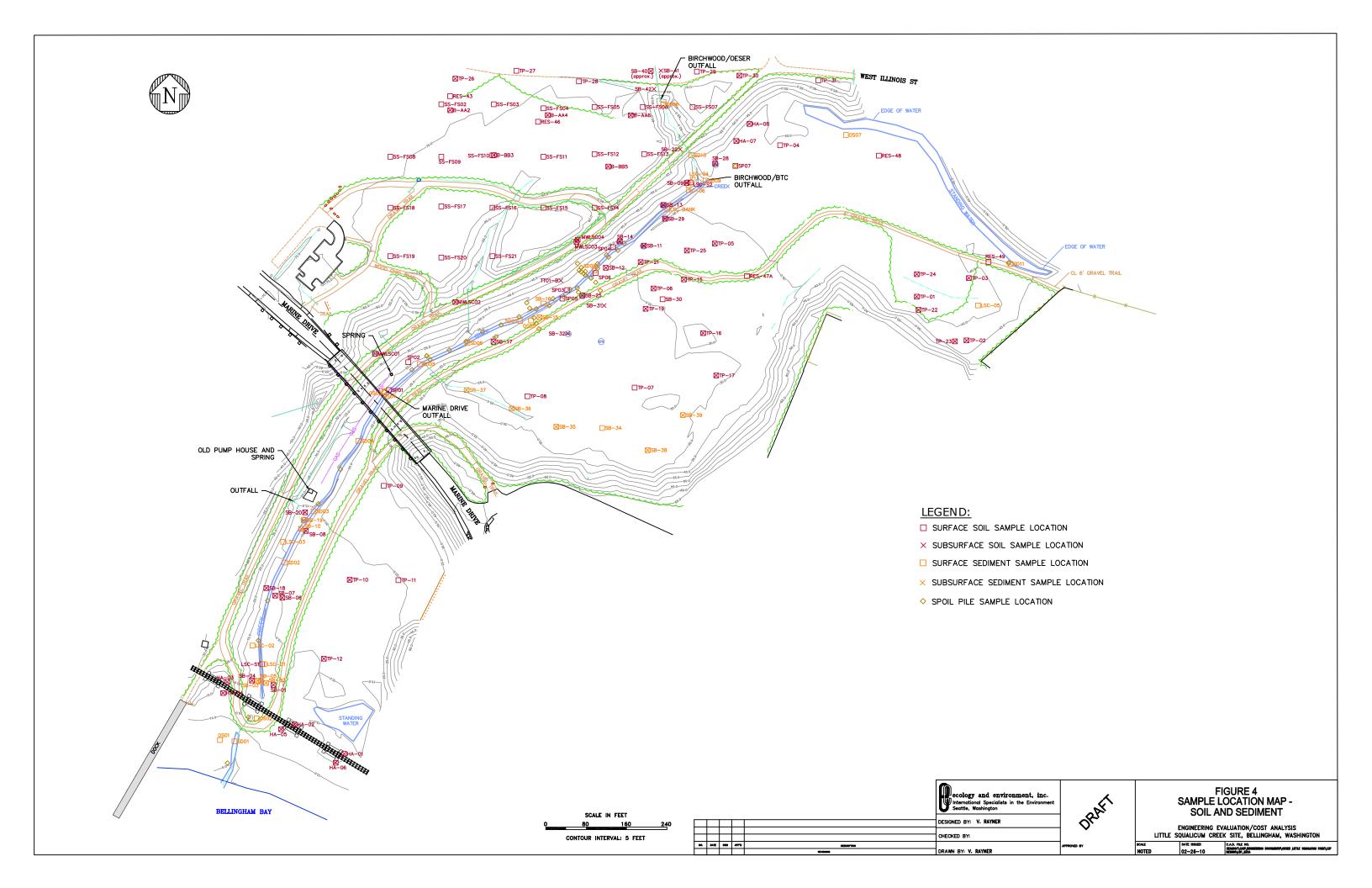
Table 5: Comparative Afternative A					
Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal or Consolidation on the Oeser Property (Option A / Option B / Option C)	Alternative 3: Excavation, Consolidation, Capping, and Creek Reroute	Alternative 4: Excavation, Consolidation, Capping, and Creek Reroute back through the Historical Creek Channel	Alternative 5: Excavation, Consolidation, Capping, and Long Creek Reroute back through the Historical Creek Channel
EFFECTIVENESS	Overall – not effective	Overall – very effective	Overall - effective	Overall - effective	Overall - effective
Protectiveness					
Protective of public health and community	No	Yes	Yes	Yes	Yes
Protective of workers during implementation	No workers required for implementation	Yes – engineering controls to be used	Yes – engineering controls to be used	Yes – engineering controls to be used	Yes – engineering controls to be used
Protective of the environment	No	Yes	Yes	Yes	Yes
Complies with ARARs	No	Yes	Yes	Yes	Yes
Ability to Achieve Removal Action Objectives					
Level of treatment/containment expected	None	Removal of contaminated soil/sediment above a 6-foot depth	Partial removal and high level of containment	Partial removal and high level of containment	Partial removal and high level of containment
No residual effect concerns	Significant residual effect concerns remain	Yes	Yes	Yes	Yes
Will maintain control until long-term solution is implemented	Would not implement any controls	Action is proposed long-term solution	Action is proposed long-term solution	Action is proposed long-term solution	Action is proposed long-term solution
IMPLEMENTABILITY	Overall – technically implementable, but not likely administratively implementable	Overall – implementable	Overall – implementable	Overall – implementable	Overall – implementable
Technical Feasibility					
Construction and operational considerations	No construction or operations required	Moderate level of operational requirements – excavation and hauling. Alternative 2, Option C may be subject to limited space at the Oeser facility for consolidation.	High level of operational requirements – excavation, staging, new creek route construction, cap construction, and closure	High level of operational requirements – excavation, staging, new creek route construction, cap construction, and closure	High level of operational requirements – excavation, staging, new creek route construction, cap construction, and closure
Demonstrated performance/useful life	Performance and useful life of technology is inapplicable	Better than adequate life expectancy	Adequate life expectancy	Adequate life expectancy	Adequate life expectancy
Adaptable to environmental conditions	Environmental conditions would not make site more or less of a threat	Yes	Yes	Yes	Yes
Can be implemented in one year	Yes	Yes	Yes	Yes	Yes
Availability					
Equipment	Requires no equipment	Yes	Yes	Yes	Yes
Personnel and services	Requires no personnel or services	Yes	Yes	Yes	Yes
Outside laboratory testing capacity	Requires no laboratory testing	Yes	Yes	Yes	Yes
Off-site treatment and disposal capacity	Requires no off-site treatment or disposal	Yes	Yes	Yes	Yes
Post-removal site control and monitoring	Requires no post-removal site control	Requires no post-removal site control	Required	Required	Required
Administrative Feasibility					
Permits required	No	No, only substantive requirements are required to be met	No, only substantive requirements are required to be met	No, only substantive requirements are required to be met	No, only substantive requirements are required to be met
Easements or right-of-way required	No	Yes, from BNSF if excavating near railroad foundation from estuary area	Yes, from BNSF if excavating near railroad foundation from estuary area	Yes, from BNSF if excavating near railroad foundation from estuary area	Yes, from BNSF if excavating near railroad foundation from estuary area
Impact on adjoining property	The potential for the site to impact adjoining property would remain unchanged	Substantial use of adjacent roads, public to be excluded from site, excavation near BNSF railroad foundation	Public to be excluded from site, excavation near BNSF railroad foundation	Public to be excluded from site, excavation near BNSF railroad foundation	Public to be excluded from site, excavation near BNSF railroad foundation
Ability to impose institutional controls	No institutional controls would be imposed	Yes	Yes	Yes	Yes
Community and stakeholder acceptance	Acceptability to LSC Site stakeholders and public to be determined following review of comments	Acceptability to LSC Site stakeholders and public to be determined following review of comments	Acceptability to LSC Site stakeholders and public to be determined following review of comments	Acceptability to LSC Site stakeholders and public to be determined following review of comments	Acceptability to LSC Site stakeholders and public to be determined following review of comments
COST	Overall – \$0	Overall - \$3,342,700 / \$7,530,400 / \$2,066,200	Overall – \$1,150,100	Overall – \$1,457,500	Overall – \$1,961,000
Direct capital cost (i.e., construction, materials, transportation)	\$0	\$2,652,800 / \$5,976,400 / \$1,639,800	\$903,500	\$1,150,500	\$1,551,800
Indirect capital cost (i.e., legal, engineering, administrative)	\$0	\$689,900 / \$1,554,000 / \$426,400	\$235,100	\$299,300	\$403,700
Post-removal action site control, maintenance and monitoring cost	\$0	\$0	\$11,500	\$7,700	\$5,500

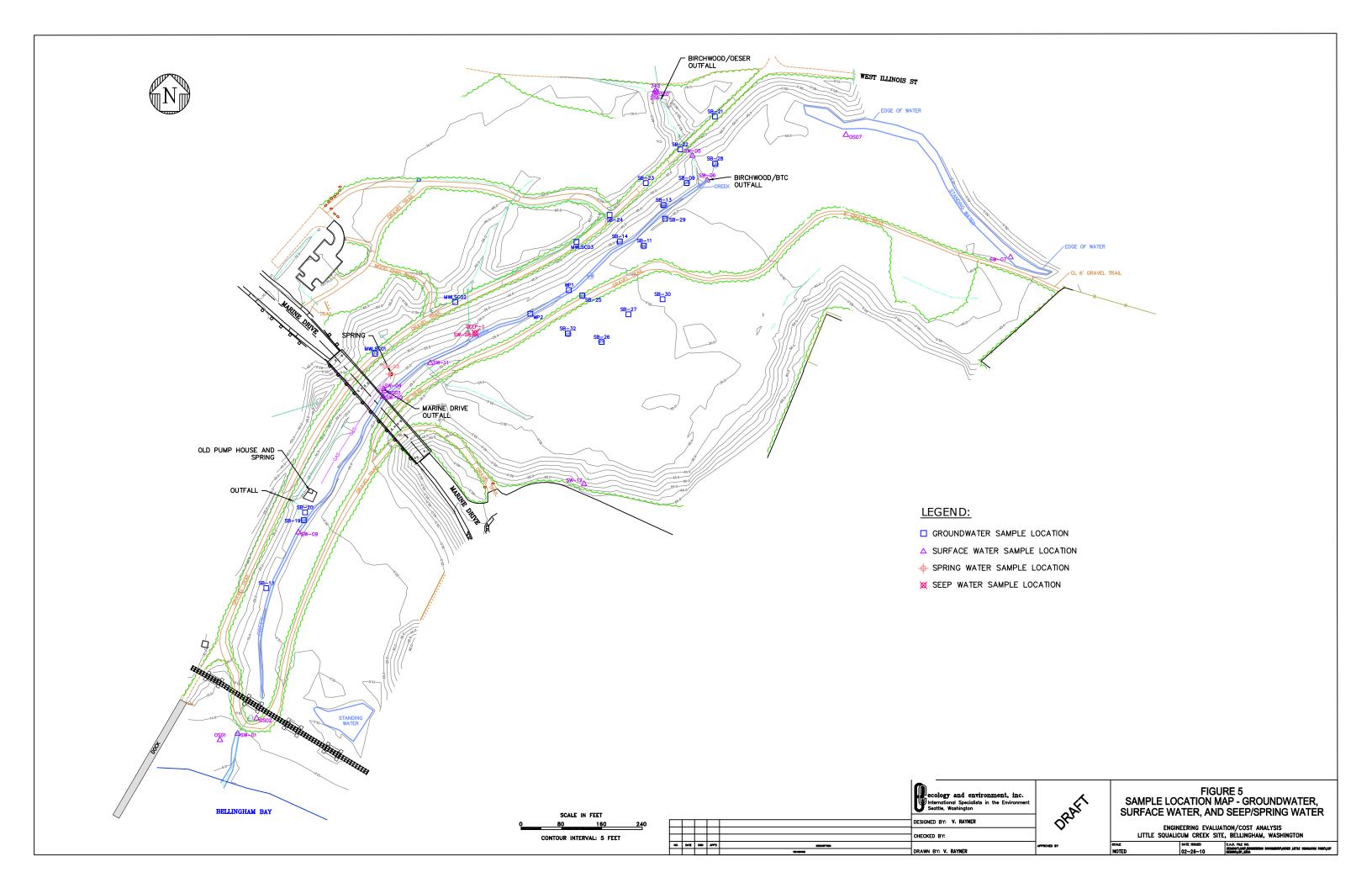
# 12 Figures

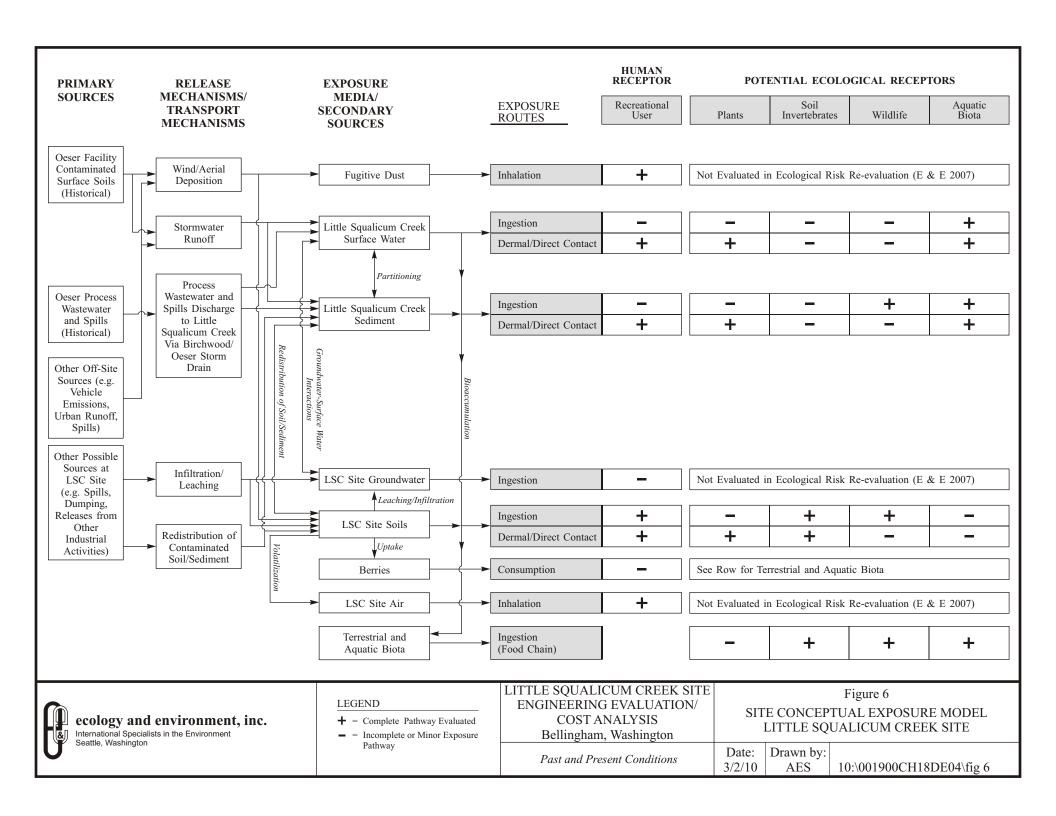


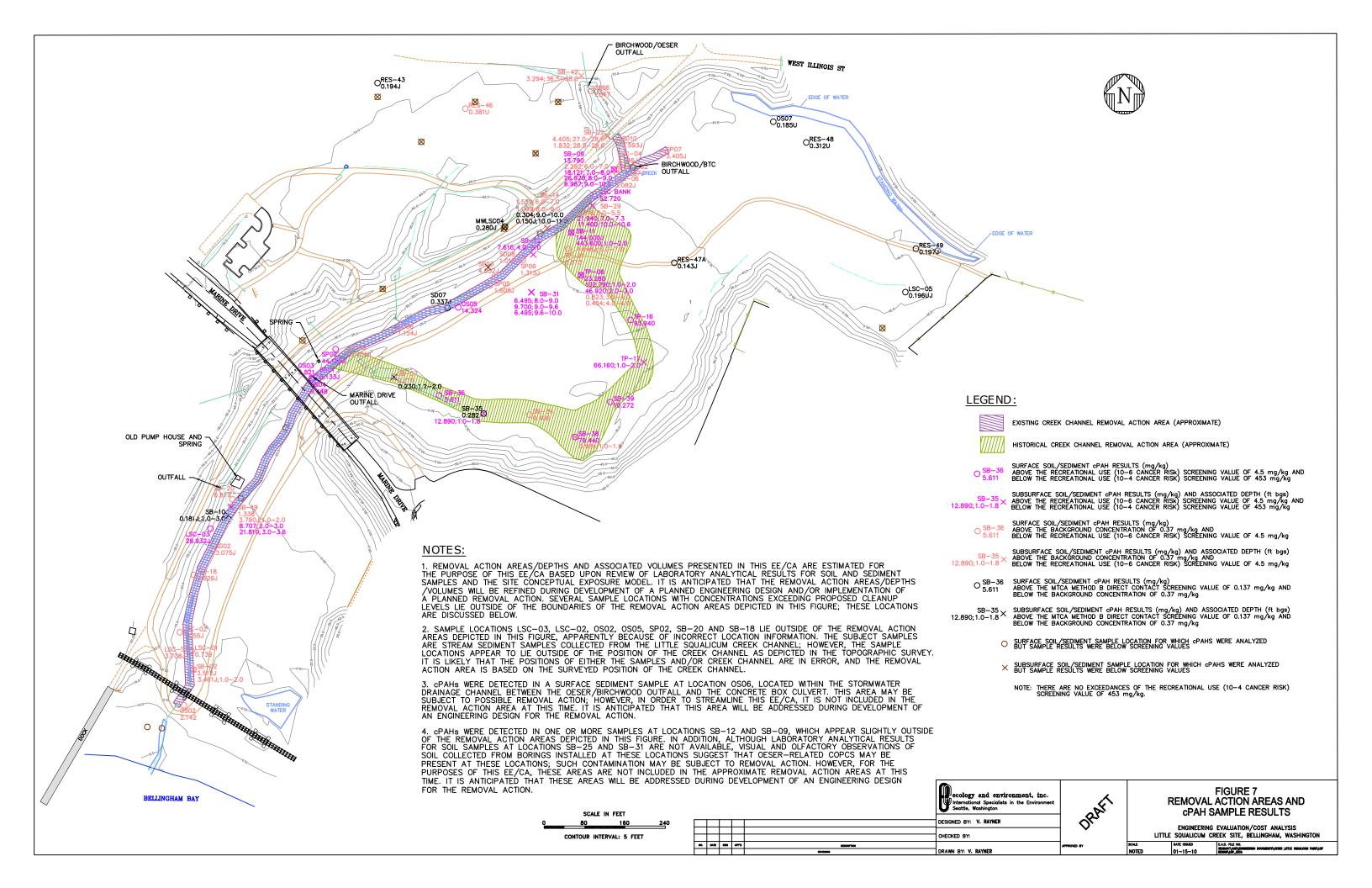


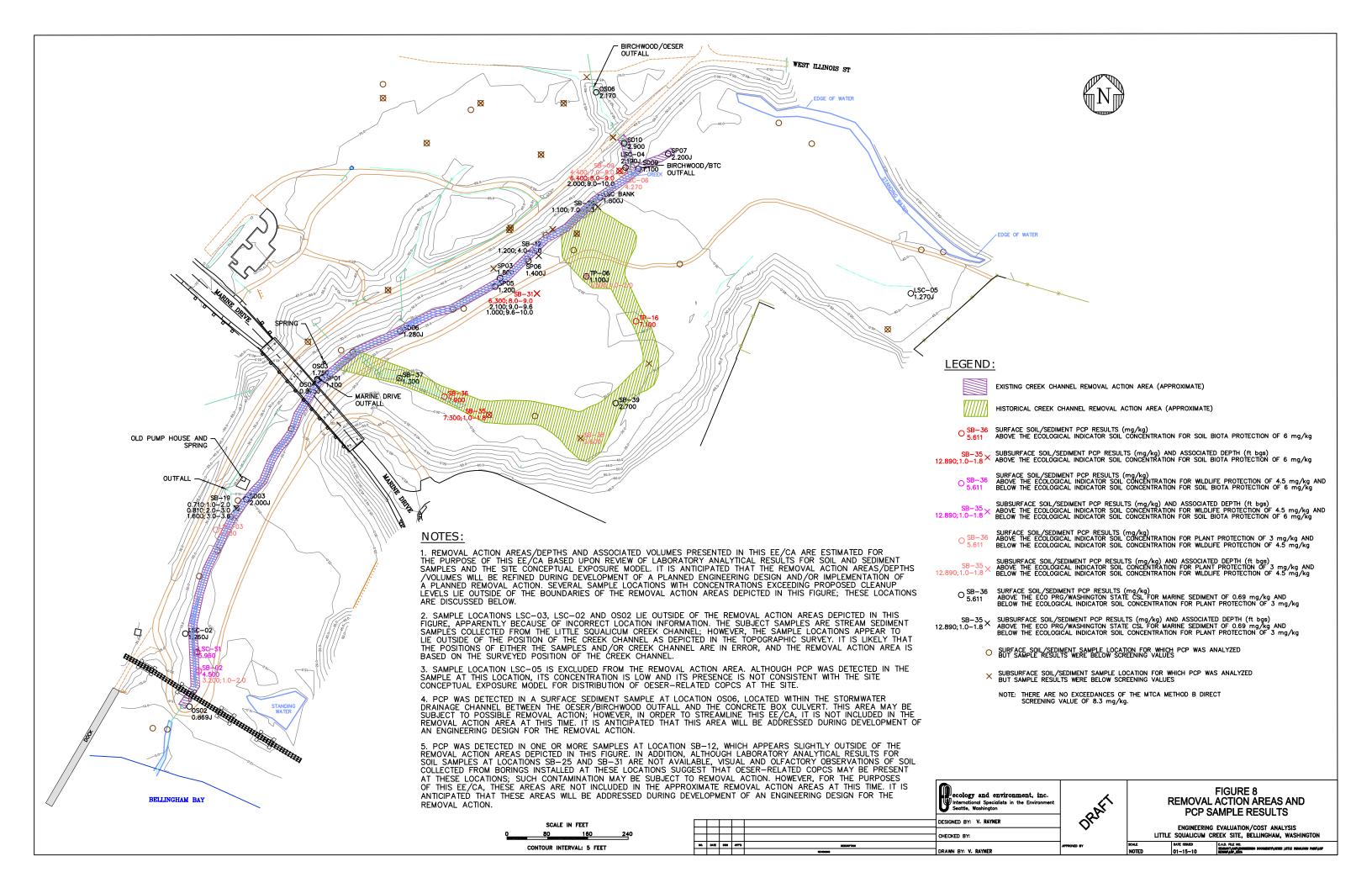


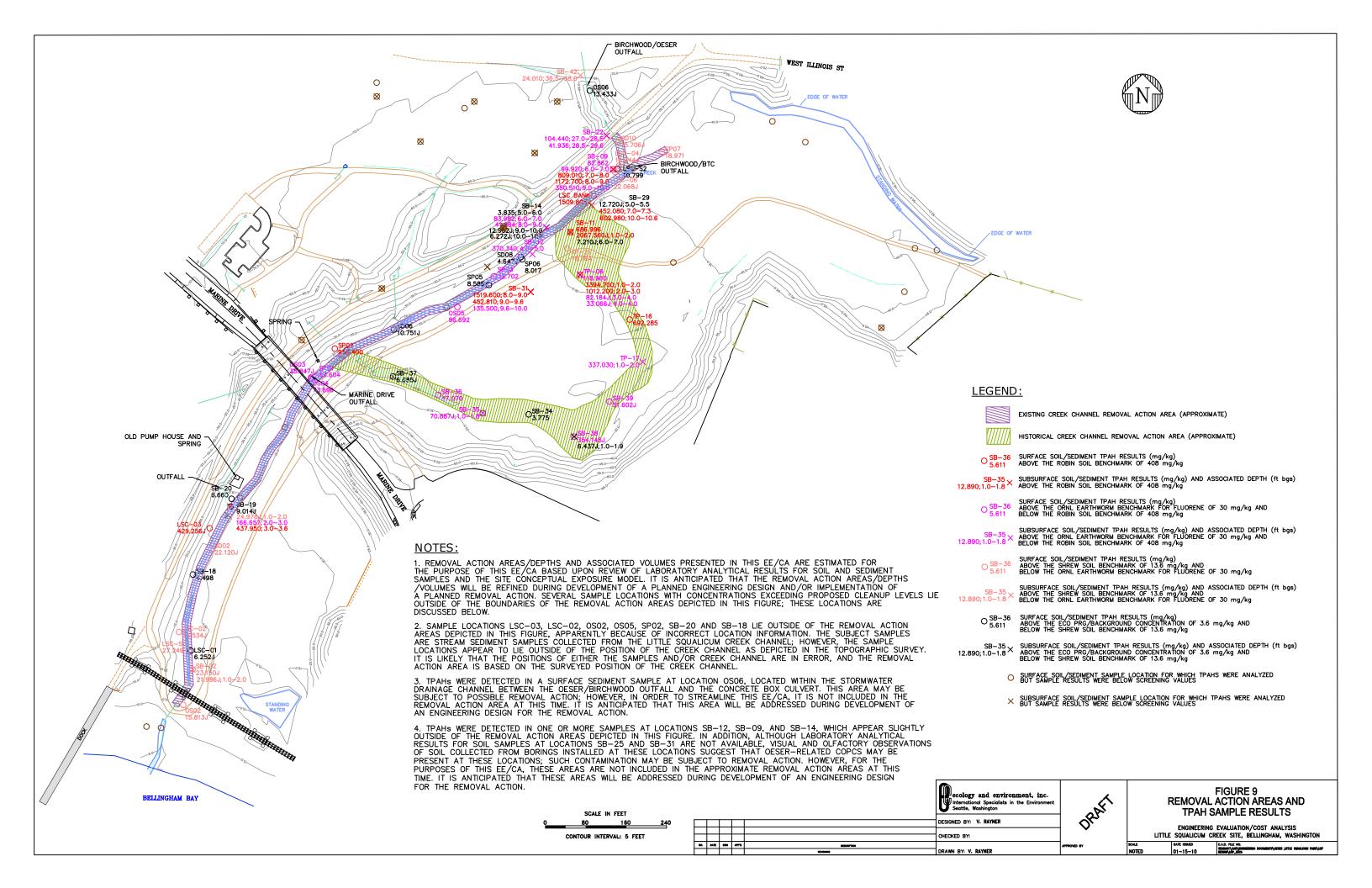


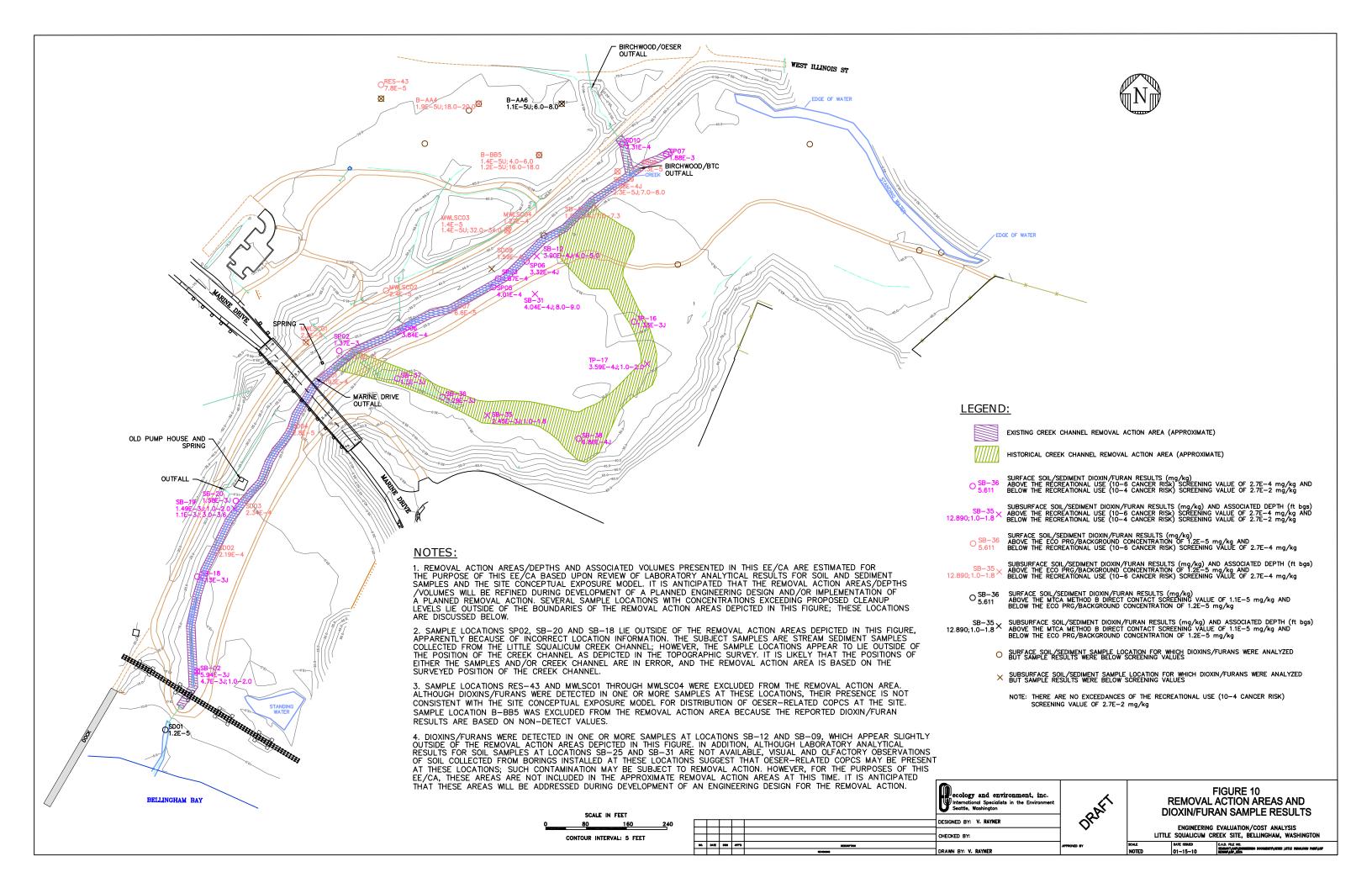


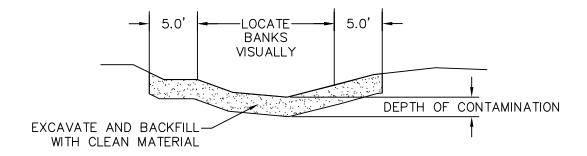










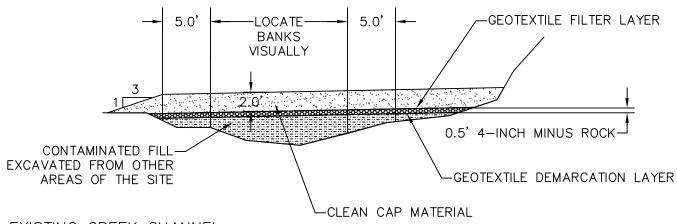


EXISTING CREEK CHANNEL

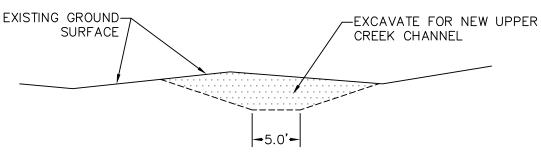
ALTERNATIVE 2: ENTIRE CHANNEL (STA 10+00A TO 25+65A)

ALTERNATIVES 3 AND 4: UPPER REACH (STA 10+00A TO 11+00A) AND LOWER REACH (STA 17+73A TO 25+65A)

ALTERNATIVE 5: UPPER REACH (STA 10+00A TO 11+00A), MIDDLE REACH (STA 17+73A TO 19+55A), AND LOWER REACH (STA 24+50A TO 25+65A)

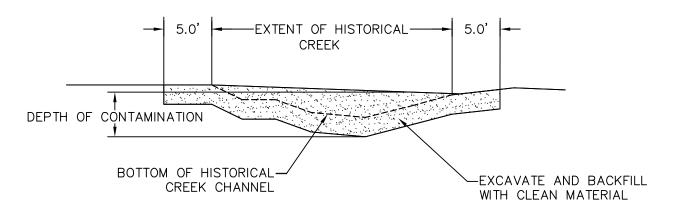


EXISTING CREEK CHANNEL ALTERNATIVES 3, 4 AND 5: MIDDLE REACH (STA 11+00A TO 17+73A)

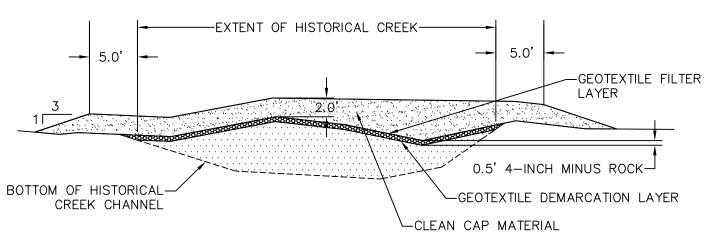


NEW CREEK CHANNEL

ALTERNATIVE 3: STA 80+00D TO 89+32D ALTERNATIVE 4: STA 100+00E TO 111+25E ALTERNATIVE 5: STA 200+00F TO 221+50F

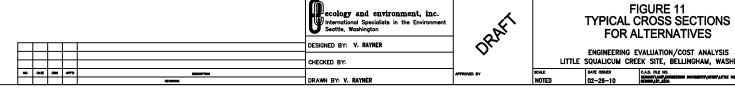


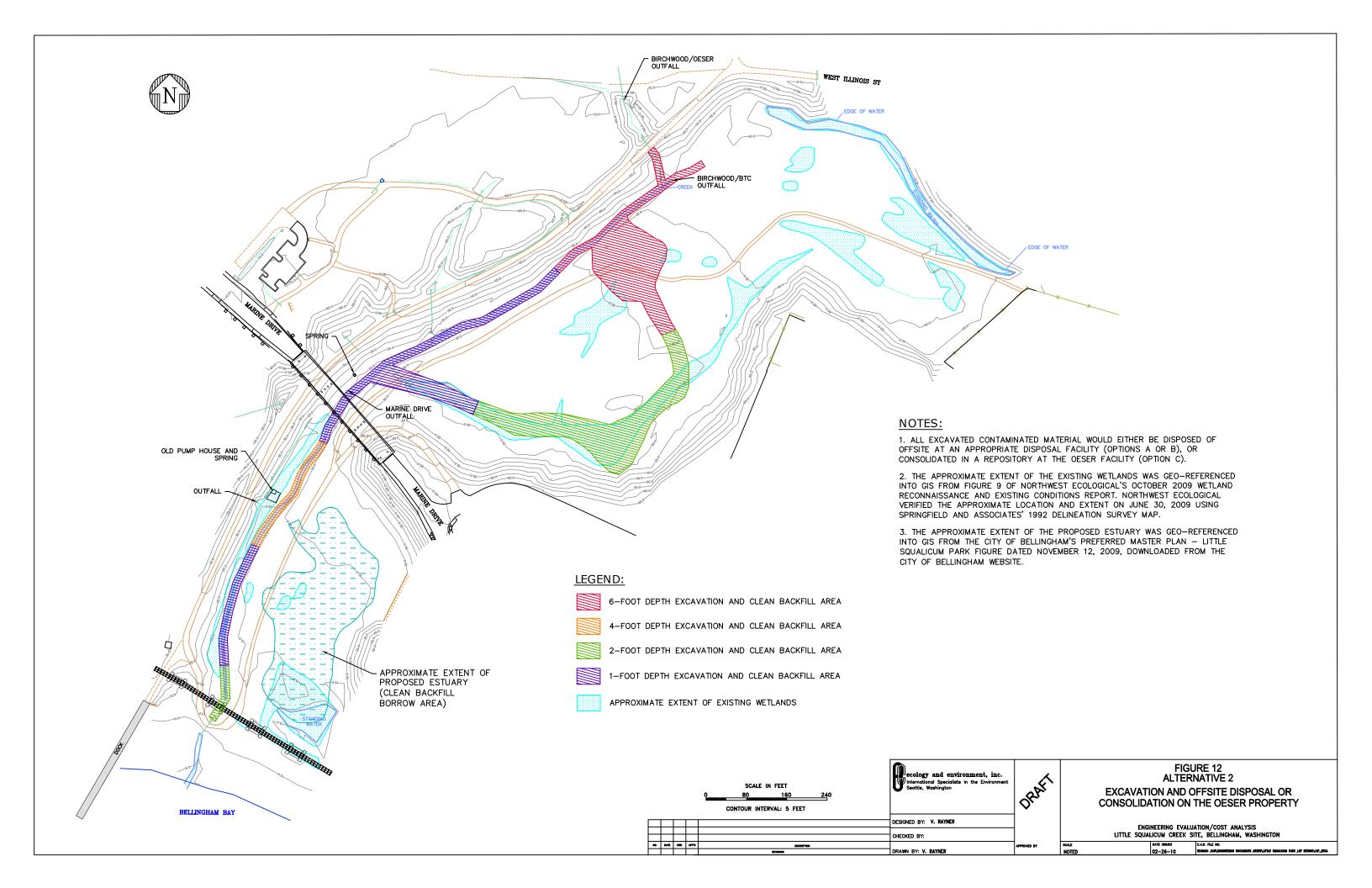
HISTORICAL CREEK CHANNEL
ALTERNATIVES 2 AND 5: ENTIRE CHANNEL (STA 30+00B TO 40+54B)
ALTERNATIVE 4: LOWER REACH (STA 32+60B TO 40+54B)

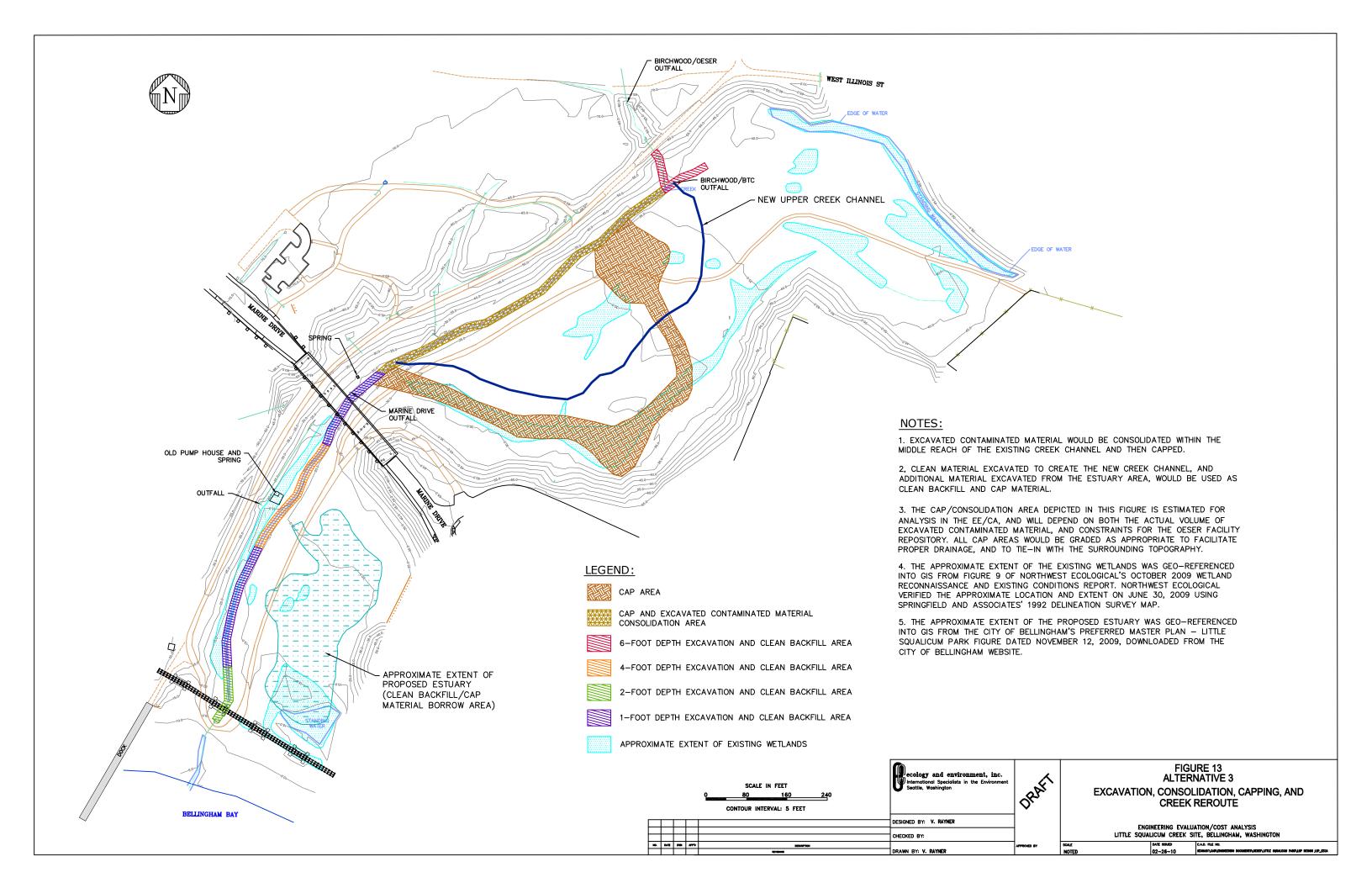


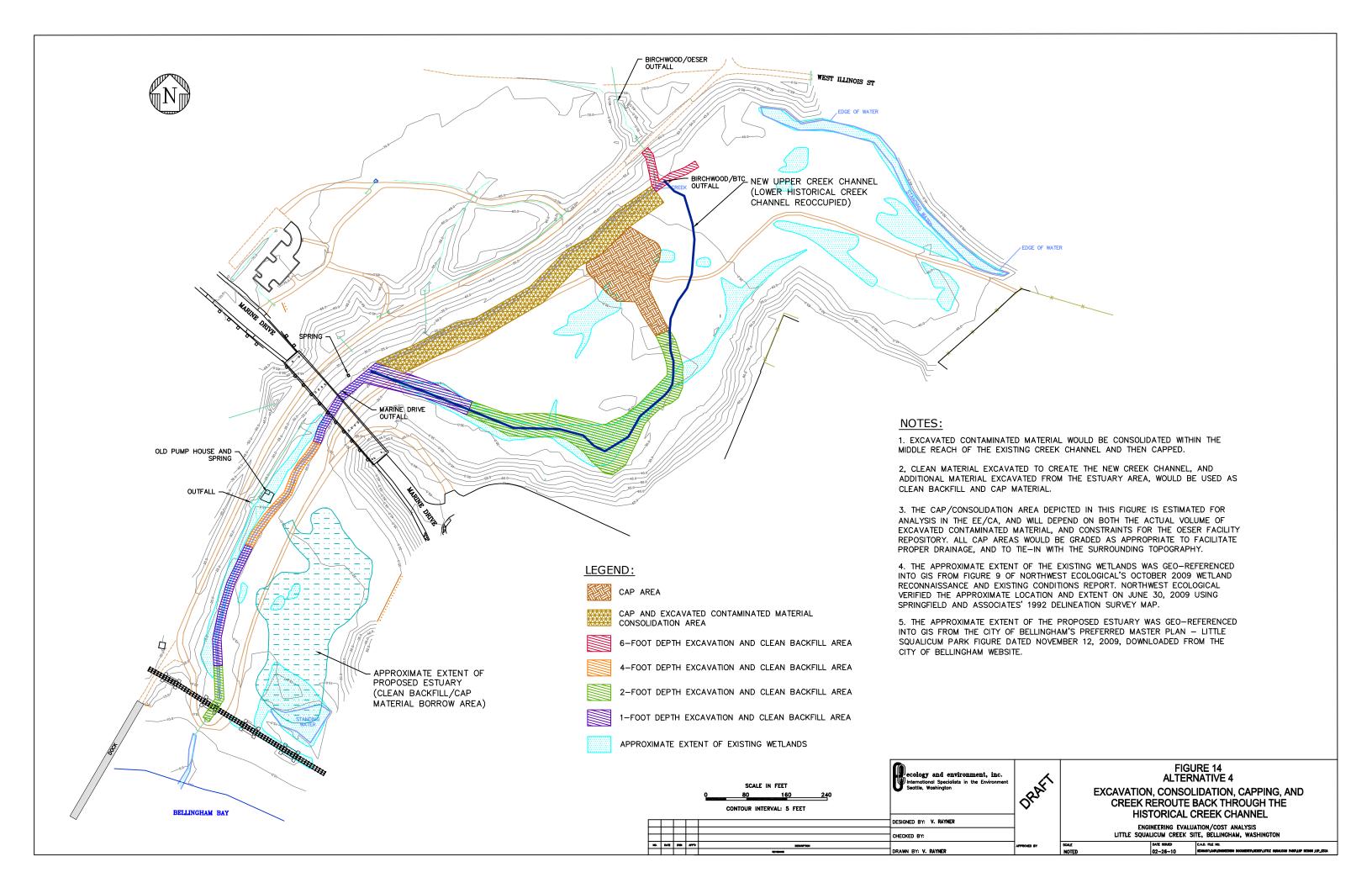
HISTORICAL CREEK CHANNEL

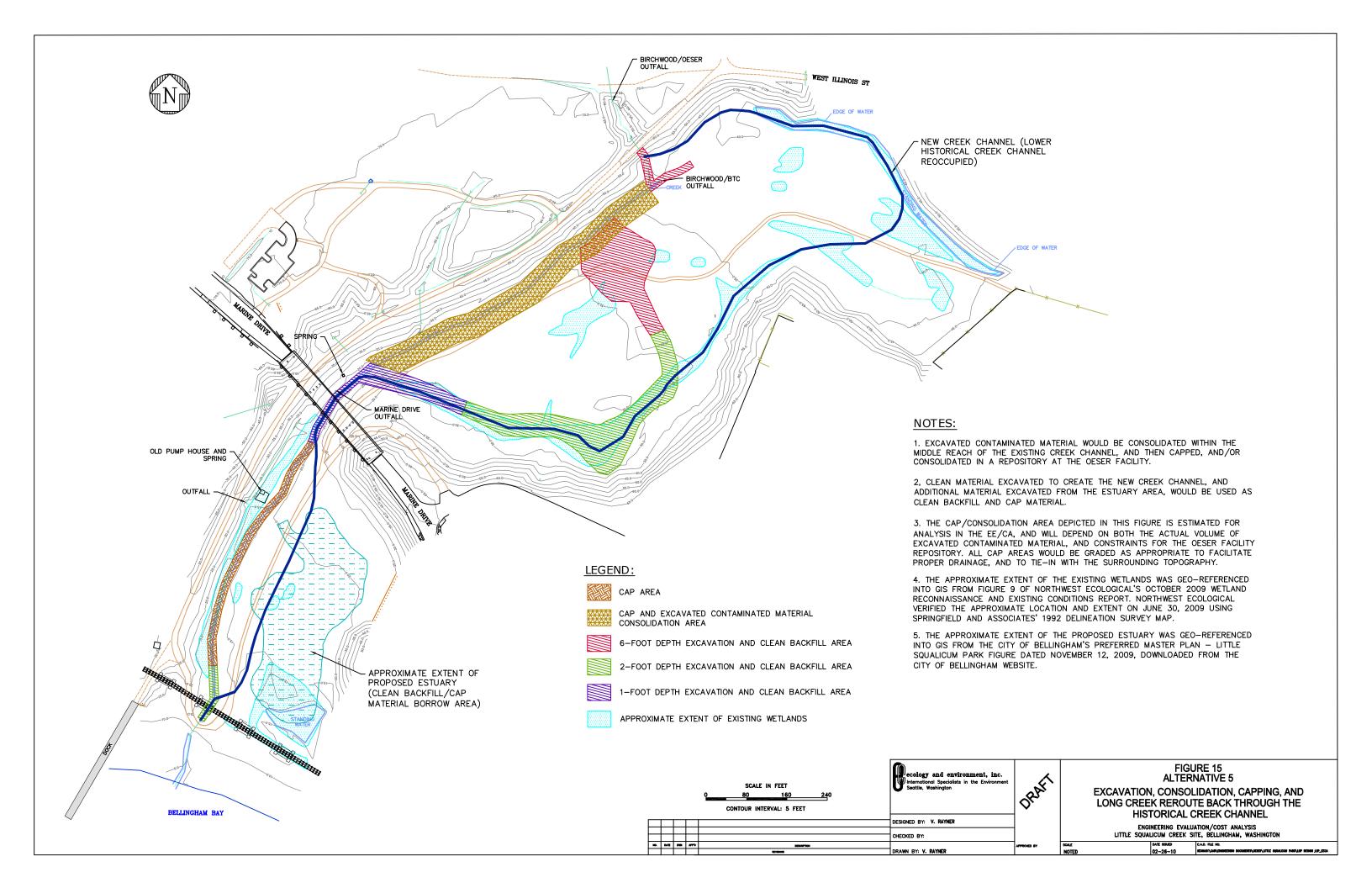
ALTERNATIVE 3: ENTIRE CHANNEL (STA 30+00B TO 40+54B) ALTERNATIVE 4: UPPER REACH (STA 30+30B TO 32+60B)













# Analytical Data



Table ECO-1.	Pentachloro	phenol Result	s for Surf	ace Water a	ıt Little Squali	cum Park <sup>1</sup> .						RA Value <sup>2</sup>
Site Area	Event	Location	On_Site	Sample_ID	Sampling_Date	Matrix	Source	Analyte	VALUE_conv	Qualifier	Units_conv	(ug/L)
Beach	OESER_RI	OS01	Yes	95372614	1/1/1996	Surface Water	ESI	Pentachlorophenol	2.2	U	ug/l	1.1
Lower creek	OESER_RI	OS02	Yes	95372616	1/1/1996	Surface Water	ESI	Pentachlorophenol	2.2	U	ug/l	1.1
Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	Pentachlorophenol	0.055		ug/l	0.055
Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	Pentachlorophenol	14		ug/l	14
Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Lower creek	Integral RI	SW-01	Yes	LSP0001	11/1/2005	Surface Water	LSP RI	Pentachlorophenol	13		ug/l	13
Lower creek	Integral RI	SW-09	Yes	LSP0002	11/1/2005	Surface Water	LSP RI	Pentachlorophenol	15		ug/l	15
Lower creek	Integral RI	SW-01	Yes	LSP0583	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Lower creek	Integral RI	SW-09	Yes	LSP0584	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	OESER_RI	OS03	Yes	95372612	1/1/1996	Surface Water	ESI	Pentachlorophenol	2.2	U	ug/l	1.1
Upper creek	OESER_RI	256	Yes	97040256	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	1.5		ug/l	1.5
Upper creek	OESER_RI	320	Yes	97040320	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	17	J	ug/l	17
Upper creek	OESER_RI	343	Yes	97040343	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	0.52	UJ	ug/l	0.26
Upper creek	OESER_RI	SEEP-1	Yes	99244027	6/10/1999	Seep	RI	Pentachlorophenol	0.48	U	ug/l	0.24
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	Pentachlorophenol	0.063		ug/l	0.063
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	Pentachlorophenol	0.05	U	ug/l	0.025
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	Pentachlorophenol	0.027	JL	ug/l	0.027
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	Pentachlorophenol	0.042	JL	ug/l	0.042
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	Pentachlorophenol	0.025	UJK	ug/l	0.013
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	Pentachlorophenol	0.024	UJK	ug/l	0.012
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	Pentachlorophenol	8.5		ug/l	8.5
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	Pentachlorophenol	7.2		ug/l	7.2
Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	Pentachlorophenol	21		ug/l	21
Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	Pentachlorophenol	0.17		ug/l	0.170
Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	Pentachlorophenol	0.33		ug/l	0.33
Upper creek	Integral RI	SW-04	Yes	LSP0003	11/1/2005	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	Pentachlorophenol	140		ug/l	140
Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-04	Yes	LSP0585	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-06	Yes	LSP0586	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-10	No	LSP0590	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-11	Yes	LSP0599	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Wetlands	OESER_RI	OS07	Yes	95352507	1/1/1996	Surface Water	ESI	Pentachlorophenol	2.1	U	ug/l	1.1
Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	Pentachlorophenol	0.025	UJK	ug/l	0.013
Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	Pentachlorophenol	0.065		ug/l	0.065
Wetlands	Integral RI	SW-07	Yes	LSP0007	11/2/2005	Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Wetlands	Integral RI	SW-07	Yes	LSP0589	4/27/2006	Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes

Available PCP screening values (see Table SV-2 for notes on applicability):

<sup>1.</sup> Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

<sup>2.</sup> RA (Risk Assessment) Value = Undetected results are included in this column at 0.5 times the reported quantitation limit.

Table ECO-2a. High Molecular Weight PAH Results (ND = 1/2DL) for Surface Water at Little Squalicum Park <sup>1</sup>.

Table ECO-2a.	riigii wolet	ulai Welgili FAI	n Kesuits (	ND - 1/2DL	) ioi Suriace v	valei al Lille Si	qualiculii Fali	Λ.			
Site Area	Event	Location	On Site	Sample ID	Sampling Date	Matrix	Source	Analyte <sup>2</sup>	Value	Qualifier	Units
Beach	OESER_RI	OS01	Yes	95372614	1/1/1996	Surface Water	ESI	HPAH (ND = 1/2 DL)	2.912	J	ug/l
Lower creek	OESER_RI	OS02	Yes	95372616	1/1/1996	Surface Water	ESI	HPAH (ND = 1/2 DL)	2.017	J	ug/l
Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.309		ug/l
Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.22805		ug/l
Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.0047	U	ug/l
Lower creek	Integral RI	SW-01	Yes	LSP0001	11/1/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Lower creek	Integral RI	SW-09	Yes	LSP0002	11/1/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Lower creek	Integral RI	SW-01	Yes	LSP0583	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Lower creek	Integral RI	SW-09	Yes	LSP0584	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	OESER_RI	OS03	Yes	95372612	1/1/1996	Surface Water	ESI	HPAH (ND = 1/2 DL)	0.45	U	ug/l
Upper creek	OESER_RI	256	Yes	97040256	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 1/2 DL)	0.6015		ug/l
Upper creek	OESER_RI	320	Yes	97040320	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 1/2 DL)	0.266		ug/l
Upper creek	OESER_RI	343	Yes	97040343	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 1/2 DL)	0.087	J	ug/l
Upper creek	OESER_RI	SEEP-1	Yes	99244027	6/10/1999	Seep	RI	HPAH (ND = 1/2 DL)	0.0566		ug/l
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.1586		ug/l
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	HPAH (ND = 1/2 DL)	0.11405		ug/l
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.1058		ug/l
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.1002		ug/l
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.0578		ug/l
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	HPAH (ND = 1/2 DL)	0.07685		ug/l
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.2214		ug/l
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	HPAH (ND = 1/2 DL)	0.0047	U	ug/l
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.16475		ug/l
Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.78335		ug/l
Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.1316		ug/l
Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	HPAH (ND = 1/2 DL)	1.041		ug/l
Upper creek	Integral RI	SW-04	Yes	LSP0003	11/1/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	5.16	J	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-04	Yes	LSP0585	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0586	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-10	No	LSP0590	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-11	Yes	LSP0599	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	UJ	ug/l
Wetlands	OESER_RI	OS07	Yes	95352507	1/1/1996	Surface Water	ESI	HPAH (ND = 1/2 DL)	1.924	J	ug/l
Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.056	J	ug/l
Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	HPAH (ND = 1/2 DL)	0.0379	J	ug/l
Wetlands	Integral RI	SW-07	Yes	LSP0007	11/2/2005	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.48	UJ	ug/l
Wetlands	Integral RI	SW-07	Yes	LSP0589	4/27/2006	Surface Water	LSP RI	HPAH (ND = 1/2 DL)	0.72	liii	ug/l

Source: Ecology and Environment. Inc., (E&E) March 2008.

#### Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

2. One half of detection limit used for non-detects.

## Key:

DL = detection limit

HPAH = high molecular weight PAH

ND = non-detect

PAH = polycyclic aromatic hydrocarbon

Available HPAH screening values (see Table SV-2 for notes on applicability):

Freshwater Toxicity Reference Value for HPAHs. 0.014 ug/L

Table ECO-2b. High Molecular Weight PAH Results (ND = 0) for Surface Water at Little Squalicum Park <sup>1</sup>.

Since Area   Event   Location   On Site   Sample   D   Sample   Sample   D   Sample   Sam	Table LOO 25.	i ngir moroca	iai troigili i i i	· · · · · · · · · · · · · · · · · · ·	0, .0. 0	Januaco Trato.	at Entire equality	ann and i				
Lower creek   DESER_RI   DS02	Site Area	Event	Location	On Site	Sample ID	Sampling Date	Matrix	Source	Analyte <sup>2</sup>	Value	Qualifier	Units
Lower creek   OESER, R  SW-01   Yes   93314150   7726/1998 Surface Water   R    HPAH (ND = 0)   0.224   0.91	Beach	OESER_RI	OS01	Yes	95372614	1/1/1996	Surface Water	ESI	HPAH (ND = 0)	2.052	J	ug/l
Lower creek   OESER RI   SW-01   Yes   99504002   128/1998 Surface Water   RI   HPAH (ND = 0)   0.221   0.91	Lower creek	OESER_RI	OS02	Yes	95372616	1/1/1996	Surface Water	ESI	HPAH (ND = 0)	0.037	J	ug/l
Lower creek   DESER RI   SW-09   Yes   99504002   12/8/1999   Surface Water   RI   HPAH (ND = 0)   0.0047   U ug/l Ug/l Ug/l Cover creek   Integral RI   SW-01   Yes   LSP0001   11/1/2005 Surface Water   LSP RI   HPAH (ND = 0)   0.48   UJ ug/l Ug/l Ug/l Ug/l Ug/l Ug/l Ug/l Ug/l U	Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	HPAH (ND = 0)	0.234		ug/l
Lower creek   Integral R   SW-01   Yes   LSP0001   111/1/2005 Surface Water   LSP R   HPAH (ND = 0)   0.48 UJ   Ug1   Ug1   Uover creek   Integral R   SW-09   Yes   LSP0002   111/1/2005 Surface Water   LSP R   HPAH (ND = 0)   0.48 UJ   Ug1   Ug1   Uover creek   Integral R   SW-09   Yes   LSP0583   4/27/2006 Surface Water   LSP R   HPAH (ND = 0)   0.72 UJ   Ug1   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.72 UJ   Ug1   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.72 UJ   Ug1   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.72 UJ   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.72 UJ   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.45 U   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.45 U   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.45 U   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.45 U   Ug1   Upper creek   USP R   HPAH (ND = 0)   0.45 U   Ug1   Upper creek   USP R   USP R	Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	HPAH (ND = 0)	0.221		ug/l
Lower creek   Integral R   SW-09   Yes   LSP0002   11/1/2005   Surface Water   LSP R   HPAH (ND = 0)   0.48   UJ   ug/l   Ug/l   Lower creek   Integral R   SW-01   Yes   LSP0583   42/7/2006 Surface Water   LSP R   HPAH (ND = 0)   0.72   UJ   ug/l   Ug/	Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	HPAH (ND = 0)	0.0047	U	ug/l
Lower creek   Integral RI   SW-01   Yes   LSP0683   4/27/2006   Surface Water   LSP RI   HPAH (ND = 0)   0.72   UJ   ug1	Lower creek	Integral RI	SW-01	Yes	LSP0001	11/1/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
Lower creek   Integral Ri   SW-09   Yes   LSPO584   4/27/2006   Surface Water   LSP Ri   HPAH (ND = 0)   0.72   UJ   Ug/l	Lower creek	Integral RI	SW-09	Yes	LSP0002	11/1/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
Upper creek	Lower creek	Integral RI	SW-01	Yes	LSP0583	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Upper creek	Lower creek	Integral RI	SW-09	Yes	LSP0584	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Upper creek	Upper creek	OESER_RI	OS03	Yes	95372612	1/1/1996	Surface Water	ESI	HPAH (ND = 0)	0.45	U	ug/l
Upper creek   OESER_RI   343   Yes   97040343   1/1/1998   Surface Water   RA Phase II   HPAH (ND = 0)   0.015   J   Ug/I	Upper creek	OESER_RI	256	Yes	97040256	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 0)	0.595		ug/l
Upper creek   OESER_RI   SEEP-1   Yes   99244027   6/10/1999   Seep   Ri   HPAH (ND = 0)   0.035   Ug/I	Upper creek	OESER_RI	320	Yes	97040320	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 0)	0.24		ug/l
Upper creek	Upper creek	OESER_RI	343	Yes	97040343	1/1/1998	Surface Water	RA Phase II	HPAH (ND = 0)	0.015	J	ug/l
Upper creek	Upper creek	OESER_RI	SEEP-1	Yes	99244027	6/10/1999	Seep	RI	HPAH (ND = 0)	0.035		ug/l
Upper creek         OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI         HPAH (ND = 0)         0.0688         ug/I           Upper creek         OESER_RI         SW-05         Yes         99314154         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0577         ug/I           Upper creek         OESER_RI         SW-06         Yes         99314155         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0137         ug/I           Upper creek         OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0401         ug/I           Upper creek         OESER_RI         SW-02         Yes         99504004         12/6/1999         Surface Water         RI         HPAH (ND = 0)         0.0401         ug/I           Upper creek         OESER_RI         SW-04         Yes         99504006         12/6/1999         Surface Water         RI         HPAH (ND = 0)         0.0471         ug/I           Upper creek         OESER_RI         SW-04         Yes         99504856         12/11/1999         Surface Water         RI         HPAH (ND = 0)	Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	HPAH (ND = 0)	0.077		ug/l
Upper creek   OESER_RI   SW-05   Yes   99314154   7/27/1999   Surface Water   RI   HPAH (ND = 0)   0.057   ug/I	Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	HPAH (ND = 0)	0.02		ug/l
Upper creek   OESER_RI   SW-06   Yes   99314155   7/27/1999   Surface Water   RI   HPAH (ND = 0)   0.0137   Ug/I	Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	HPAH (ND = 0)	0.0698		ug/l
Upper creek   OESER_RI   SW-08   Yes   99314158   7/27/1999   Seep   Ri   HPAH (ND = 0)   0.0401   Ug/I	Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	HPAH (ND = 0)	0.057		ug/l
Upper creek   OESER_RI   SW-02   Yes   99504004   12/6/1999 Surface Water   RI   HPAH (ND = 0)   0.212   Ug/I	Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	HPAH (ND = 0)	0.0137		ug/l
Upper creek   OESER_RI   SW-03   Yes   99504008   12/6/1999   Spring   RI   HPAH (ND = 0)   0.0047   U   ug/l	Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	HPAH (ND = 0)	0.0401		ug/l
Upper creek   OESER_RI   SW-04   Yes   99504006   12/6/1999   Surface Water   RI   HPAH (ND = 0)   0.152   ug/l	Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	HPAH (ND = 0)	0.212		ug/l
Upper creek         OESER_RI         SW-05         Yes         99504858         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.781         ug/I           Upper creek         OESER_RI         SW-06         Yes         99504860         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.121         ug/I           Upper creek         OESER_RI         SW-08         Yes         99504856         12/11/1999         Seep         RI         HPAH (ND = 0)         0.1041         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0003         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0004         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (N	Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	HPAH (ND = 0)	0.0047	U	ug/l
Upper creek         OESER_RI         SW-06         Yes         99504860         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.121         ug/I           Upper creek         OESER_RI         SW-08         Yes         99504856         12/11/1999         Seep         RI         HPAH (ND = 0)         1.041         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0003         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0004         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         H	Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	HPAH (ND = 0)	0.152		ug/l
Upper creek         OESER_RI         SW-08         Yes         99504856         12/11/1999         Seep         RI         HPAH (ND = 0)         1.041         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0003         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0004         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0008         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0586         4/27/2006         Surface Water         LSP RI	Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	HPAH (ND = 0)	0.781		ug/l
Upper creek         Integral RI         SW-04         Yes         LSP0003         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0004         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         4.6 J         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0008         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0599         4/27/2006         Surface Water         LSP R	Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	HPAH (ND = 0)	0.121		ug/l
Upper creek         Integral RI         SW-05         Yes         LSP0004         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         4.6 J         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0088         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0599         4/27/2006         Surface Water         LSP RI	Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	HPAH (ND = 0)	1.041		ug/l
Upper creek         Integral RI         SW-06         Yes         LSP0006         11/1/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0008         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP	Upper creek	Integral RI	SW-04	Yes	LSP0003	11/1/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
Upper creek         Integral RI         SW-10         No         LSP0008         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I           Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0590         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI	Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	HPAH (ND = 0)	4.6	J	ug/l
Upper creek         Integral RI         SW-04         Yes         LSP0585         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0590         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72 UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI         HPAH (ND = 0)         0.034 J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         <	Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
Upper creek         Integral RI         SW-05         Yes         LSP0587         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0590         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI         HPAH (ND = 0)         0.034         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0101         J         ug/I           Wetlands         Integral RI         SW-07         Yes         99504	Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
Upper creek         Integral RI         SW-06         Yes         LSP0586         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-10         No         LSP0590         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI         HPAH (ND = 0)         0.034         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0101         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.0238         J         ug/I           Wetlands         Integral RI         SW-07         Yes         LSP0007	Upper creek	Integral RI	SW-04	Yes	LSP0585	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Upper creek         Integral RI         SW-10         No         LSP0590         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI         HPAH (ND = 0)         0.034         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0101         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.0238         J         ug/I           Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48         UJ         ug/I	Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Upper creek         Integral RI         SW-11         Yes         LSP0599         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72         UJ         ug/I           Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996         Surface Water         ESI         HPAH (ND = 0)         0.034         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0101         J         ug/I           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.0238         J         ug/I           Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48         UJ         ug/I	Upper creek	Integral RI	SW-06	Yes	LSP0586	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Wetlands         OESER_RI         OS07         Yes         95352507         1/1/1996 Surface Water         ESI         HPAH (ND = 0)         0.034 J         ug/l           Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999 Surface Water RI         HPAH (ND = 0)         0.0101 J         ug/l           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999 Surface Water RI         HPAH (ND = 0)         0.0238 J         ug/l           Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005 Surface Water LSP RI         HPAH (ND = 0)         0.48 UJ         ug/l	Upper creek	Integral RI	SW-10	No	LSP0590	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Wetlands         OESER_RI         SW-07         Yes         99314157         7/27/1999         Surface Water         RI         HPAH (ND = 0)         0.0101         J         ug/l           Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.0238         J         ug/l           Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48         UJ         ug/l	Upper creek	Integral RI	SW-11	Yes	LSP0599	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l
Wetlands         OESER_RI         SW-07         Yes         99504862         12/11/1999         Surface Water         RI         HPAH (ND = 0)         0.0238         J         ug/l           Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48         UJ         ug/l	Wetlands	OESER_RI	OS07	Yes	95352507	1/1/1996	Surface Water	ESI	HPAH (ND = 0)	0.034	J	ug/l
Wetlands         Integral RI         SW-07         Yes         LSP0007         11/2/2005         Surface Water         LSP RI         HPAH (ND = 0)         0.48 UJ         ug/I	Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	HPAH (ND = 0)	0.0101	J	ug/l
	Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	HPAH (ND = 0)	0.0238	J	ug/l
Wetlands         Integral RI         SW-07         Yes         LSP0589         4/27/2006         Surface Water         LSP RI         HPAH (ND = 0)         0.72   UJ         ug/l	Wetlands	Integral RI	SW-07	Yes	LSP0007	11/2/2005	Surface Water	LSP RI	HPAH (ND = 0)	0.48	UJ	ug/l
	Wetlands	Integral RI	SW-07	Yes	LSP0589	4/27/2006	Surface Water	LSP RI	HPAH (ND = 0)	0.72	UJ	ug/l

Source: Ecology and Environment. Inc., (E&E) March 2008.

#### Notes

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

2. Zero used for non-detects.

## Key:

DL = detection limit

HPAH = high molecular weight PAH

ND = non-detect

PAH = polycyclic aromatic hydrocarbon

Available HPAH screening values (see Table SV-2 for notes on applicability):

Freshwater Toxicity Reference Value for HPAHs.

0.014 ug/L

Table ECO-3a. Dioxin/Furan Results (as 2,3,7,8-TCDD TEQ; ND = 1/2DL) for Surface Water at Little Squalicum Park<sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Matrix	Source	Analyte <sup>2</sup>	Value	Qualifier	Units
Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	TEQDF981/2F	1.63E-05	•	ug/l
Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	TEQDF981/2F	3.17E-05		ug/l
Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	TEQDF981/2F	1.83E-05	U	ug/l
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	TEQDF981/2F	2.99E-05		ug/l
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	TEQDF981/2F	1.91E-05	U	ug/l
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	TEQDF981/2F	2.03E-05		ug/l
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	TEQDF981/2F	1.49E-05		ug/l
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	TEQDF981/2F	3.49E-05	U	ug/l
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	TEQDF981/2F	1.25E-05		ug/l
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	TEQDF981/2F	2.76E-05		ug/l
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	TEQDF981/2F	8.39E-06		ug/L
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	TEQDF981/2F	4.82E-05		ug/l
Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	TEQDF981/2F	5.57E-05		ug/l
Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	TEQDF981/2F	1.35E-05		ug/l
Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	TEQDF981/2F	2.88E-05		ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	TEQDF981/2F	3.02E-04	J	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	TEQDF981/2F	1.87E-05	J	ug/l
Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	TEQDF981/2F	1.83E-05	J	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	TEQDF981/2F	9.22E-06	J	ug/l
Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	TEQDF981/2F	6.37E-05	U	ug/l
Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	TEQDF981/2F	2.14E-05		ug/l

Source: Ecology and Environment. Inc., (E&E) March 2008.

#### Notes

- 1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.
- 2. Based on dioxin/furan toxicity equivalence factors (TEFs) for fish from van den Berg et al. (1998). One-half of detection limit used for non-detects.

ug/L

## Key:

DL = detection limit

ND = non-detect

TCDD = tetrachlorodibenzo-p-dioxin

TEQ = toxic equivalent concentration

Available TCDD screening values (see Table SV-2 for notes on applicability):

Chronic No effects Level (Rainbow Trout)

3.8E-06

Table ECO-3b. Dioxin/Furan Results (as 2,3,7,8-TCDD TEQ; ND=0) for Surface Water at Little Squalicum Park.<sup>1</sup>

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Matrix	Source	Analyte <sup>2</sup>	Value	Qualifier	Units
Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	TEQDF F0	3.74E-07		ug/l
Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	TEQDF F0	6.62E-06		ug/l
Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	TEQDF F0	1.83E-05	U	ug/l
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	TEQDF F0	2.02E-08		ug/l
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	TEQDF F0	1.91E-05	U	ug/l
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	TEQDF F0	3.34E-08		ug/l
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	TEQDF F0	2.95E-07		ug/l
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	TEQDF F0	3.49E-05	U	ug/l
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	TEQDF F0	4.49E-07		ug/l
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	TEQDF F0	6.92E-06		ug/l
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	TEQDF F0	4.15E-08		ug/l
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	TEQDF F0	1.18E-05		ug/l
Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	TEQDF F0	1.77E-05		ug/l
Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	TEQDF F0	1.57E-07		ug/l
Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	TEQDF F0	4.69E-06		ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	TEQDF F0	3.02E-04	J	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	TEQDF F0	9.40E-08	J	ug/l
Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	TEQDF F0	7.80E-09	J	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	TEQDF F0	3.06E-06	J	ug/l
Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	TEQDF F0	6.37E-05	U	ug/l
Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	TEQDF F0	1.12E-08		ug/l

Source: Ecology and Environment. Inc., (E&E) March 2008.

#### Notes

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

2. Based on dioxin/furan toxicity equivalence factors (TEFs) for fish from van den Berg et al. (1998). Zero used for non-detects.

## Key:

DL = detection limit

ND = non-detect

TCDD = tetrachlorodibenzo-p-dioxin

TEQ = toxic equivalent concentration

## Available TCDD screening values (see Table SV-2 for notes on applicability):

Chronic No effects Level (Rainbow Trout)

3.8E-06

ug/L

Table ECO-4. F	entachlorophe	nol Results	for Soil	at Little Squ	alicum Park <sup>1</sup> .			_	•					RA Value <sup>2</sup>
Site Area	Event	Location	On Site	Sample ID	Sampling Date	Upper Depth	Lower Depth Unit	Matrix	Source	Analyte		Qualifier	Units	(mg/kg)
General Site	OESER_RI	RES-47A	Yes	99224036	5/26/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.713	U	mg/kg	0.3565
General Site	OESER_RI	RES-48	Yes	99224034	5/26/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.781	U	mg/kg	0.3905
General Site	OESER_RI	RES-49	Yes	99224035	5/26/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.678	U	mg/kg	0.339
General Site	OESER_RI	SP07	Yes	99070656	8/6/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	2.2	J	mg/kg	2.2
Historical creek	Integral RI	TP-06	Yes	LSP0047	11/8/2005	3.0	4.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.045	UJ	mg/kg	0.0225
Historical creek	Integral RI	TP-06	Yes	LSP0048	11/8/2005	4.0	4.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.046	UJ	mg/kg	0.023
Historical creek	Integral RI	TP-06	Yes	LSP0046	11/8/2005	2.0	3.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.18	J	mg/kg	0.18
Historical creek	Integral RI	TP-06	Yes	LSP0044	11/8/2005	0.0	1.0 ft	Surface Soil	LSP RI	Pentachlorophenol	1.1	J	mg/kg	1.1
Historical creek	Integral RI	TP-06	Yes	LSP0045	11/8/2005	1.0	2.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	3.5		mg/kg	3.5
Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0 ft	Surface Soil	LSP RI	Pentachlorophenol	7.1		mg/kg	7.1
Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.54	J	mg/kg	0.54
Historical creek	Integral RI	TP-21	Yes	LSP0102	11/17/2005	0.0	2.0 ft	Surface Soil	LSP RI	Pentachlorophenol	0.14	UJ	mg/kg	0.07
Illinois Street	Integral RI	SB-42	No	LSP0685	1/29/2007	36.5	38 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.13	J	mg/kg	0.13
Landfill	Integral RI	TP-23	Yes	LSP0110	1/31/2006	3.5	4.0 ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.046	UJ	mg/kg	0.023
Landfill	Integral RI	TP-23	Yes	LSP0108	1/31/2006	0.0	2.0 ft	Surface Soil	LSP RI	Pentachlorophenol	0.35	J	mg/kg	0.35
Lower creek	Ecology2003	LSC-S1	Yes	3394047	9/25/2003	0.0	0.0	Surface Soil	Ecology2003	Pentachlorophenol	5.96	J	mg/kg	5.96
Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0 ft	Surface Soil	LSP RI	Pentachlorophenol	0.41	J	mg/kg	0.41
Lower creek	Integral RI	SB-20	Yes	LSP0271	2/10/2006	0.0	1.0 ft	Surface Soil	LSP RI	Pentachlorophenol	0.4		mg/kg	0.4
South Slope	OESER_RI	RES-43	Yes	99224021	5/25/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.661	U	mg/kg	0.3305
South Slope	OESER_RI	RES-46	Yes	99224022	5/25/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.953	U	mg/kg	0.4765
South Slope	OESER_RI	B-AA2	Yes	99070532	8/3/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.015	J	mg/kg	0.015
South Slope	OESER_RI	B-AA4	Yes	99070533	8/3/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.0085	J	mg/kg	0.0085
South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.011	J	mg/kg	0.011
South Slope	OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.012	U	mg/kg	0.006
South Slope	OESER_RI	B-BB5	Yes	99070536	8/3/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.011	U	mg/kg	0.0055
South Slope	OESER_RI	B-AA2	Yes	99070587	8/5/1999	6.0	8.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.011	U	mg/kg	0.0055
South Slope	OESER_RI	B-AA4	Yes	99070589	8/5/1999	6.0	8.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.012	U	mg/kg	0.006
South Slope	OESER_RI	B-AA6	Yes	99070591	8/5/1999	6.0	8.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.012	U	mg/kg	0.006
South Slope	OESER_RI	B-AA4	Yes	99070590	8/5/1999	18	20 ft	Subsurface Soil	RI	Pentachlorophenol	0.0016		mg/kg	0.0016
South Slope	OESER_RI	B-AA6	Yes	99070592	8/5/1999	18	20 ft	Subsurface Soil	RI	Pentachlorophenol	0.01	U	mg/kg	0.005
South Slope	OESER_RI	B-AA4	Yes	99070588	8/5/1999	36	38 ft	Subsurface Soil	RI	Pentachlorophenol	0.012	U	mg/kg	0.06
South Slope	OESER_RI	B-BB3	Yes	99070596	8/6/1999	2.0	4.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.013	U	mg/kg	0.0065
South Slope	OESER_RI	B-BB5	Yes	99070593	8/6/1999	4.0	6.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.011	U	mg/kg	0.0055
South Slope	OESER_RI	B-BB5	Yes	99070595	8/6/1999	18	20 ft	Subsurface Soil	RI	Pentachlorophenol	0.011	U	mg/kg	0.0055
South Slope	OESER_RI	B-BB5	Yes	99070597	8/6/1999	18	20 ft	Subsurface Soil	RI	Pentachlorophenol	0.011	U	mg/kg	0.0055
Upper creek	OESER_RI	MWLSC04	Yes	99070539	8/2/1999	12.0	14.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.01	UJ	mg/kg	0.005
Upper creek	OESER_RI	MWLSC04	Yes	99070538	8/2/1999	4.0	6.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.011	UJ	mg/kg	0.0055
Upper creek	OESER_RI	MWLSC01	Yes	99070511	8/5/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.026		mg/kg	0.026
Upper creek	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2 ft	Surface Soil	RI	Pentachlorophenol	0.015		mg/kg	0.015
Upper creek	OESER_RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	0.0056	J	mg/kg	0.0056
Upper creek	OESER_RI	MWLSC04	Yes	99070514	8/5/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	0.41		mg/kg	0.41
Upper creek	OESER_RI	TT01-B	Yes	99070647	8/5/1999	6.0	6.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.0093	J	mg/kg	0.0093
Upper creek	OESER_RI	TT01-BW	Yes	99070649	8/5/1999	2.5	2.5 ft	Subsurface Soil	RI	Pentachlorophenol	0.0095	U	mg/kg	0.00475
Upper creek	OESER_RI	TT01-SW	Yes	99070648	8/5/1999	4.0	4.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.01	U	mg/kg	0.005
Upper creek	OESER_RI	MWLSC01	Yes	99070540	8/6/1999	10.0	12.0 ft	Subsurface Soil	RI	Pentachlorophenol	0.01	UJ	mg/kg	0.005
Upper creek	OESER_RI	SP01	Yes	99070650	8/6/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	1.1		mg/kg	1.1
Upper creek	OESER_RI	SP02	Yes	99070651	8/6/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	0.15	UJ	mg/kg	0.075
Upper creek	OESER_RI	SP03	Yes	99070652	8/6/1999	0.0	0.5 ft	Surface Soil	RI	Pentachlorophenol	1.8		mg/kg	1.8

Upper creek	OESER_RI	SP04	Yes	99070653	8/6/1999	0.0	0.5	ft	Surface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
Upper creek	OESER_RI	SP05	Yes	99070654	8/6/1999	0.0	0.5	ft	Surface Soil	RI	Pentachlorophenol	1.2	mg/kg	1.2
Upper creek	OESER_RI	SP06	Yes	99070655	8/6/1999	0.0	0.5	ft	Surface Soil	RI	Pentachlorophenol	1.4 J	mg/kg	1.4
Upper creek	OESER_RI	MWLSC01	Yes	99070541	8/6/1999	18	20	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 UJ	mg/kg	0.06
Upper creek	OESER_RI	MWLSC01	Yes	99070542	8/6/1999	34	36	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 UJ	mg/kg	0.055
Upper creek	OESER_RI	MWLSC02	Yes	99070545	8/7/1999	10.0	12.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
Upper creek	OESER_RI	MWLSC02	Yes	99070546	8/7/1999	22	24	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.055
Upper creek	OESER_RI	MWLSC03	Yes	99070543	8/7/1999	28	30	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 U	mg/kg	0.06
Upper creek	OESER_RI	MWLSC02	Yes	99070547	8/7/1999	30	32	ft	Subsurface Soil	RI	Pentachlorophenol	0.013 U	mg/kg	0.065
Upper creek	OESER_RI	MWLSC03	Yes	99070544	8/7/1999	32	34	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 U	mg/kg	0.06
Upper creek	Ecology2003	LSC-S2	Yes	3394048	9/25/2003	0.0	0.0		Surface Soil	Ecology2003	Pentachlorophenol	0.673 J	mg/kg	0.673
Upper creek	Integral RI	SB-09	Yes	LSP0176	2/6/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.46	mg/kg	0.46
Upper creek	Integral RI	SB-09	Yes	LSP0179	2/6/2006	9.0	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	2	mg/kg	2
Upper creek	Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	4.4	mg/kg	4.4
Upper creek	Integral RI	SB-09	Yes	LSP0178	2/6/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	6.4	mg/kg	6.4
Upper creek	Integral RI	SB-11	Yes	LSP0191	2/7/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.046 UJ	mg/kg	0.023
Upper creek	Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1.2	mg/kg	1.2
Upper creek	Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0	ft	Surface Soil	LSP RI	Pentachlorophenol	0.375	mg/kg	0.375
Upper creek	Integral RI	SB-14	Yes	LSP0220	2/8/2006	5.0	6.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.047 UJ	mg/kg	0.0235
Upper creek	Integral RI	SB-14	Yes	LSP0219	2/8/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.1 UJ	mg/kg	0.05
Upper creek	Integral RI	SB-14	Yes	LSP0222	2/8/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-14	Yes	LSP0223	2/8/2006	9.0	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-14	Yes	LSP0221	2/8/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.16	mg/kg	0.16
Upper creek	Integral RI	SB-14	Yes	LSP0226	2/9/2006	10.0	11.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-11	Yes	LSP0274	2/11/2006	0.0	1.0	ft	Surface Soil	LSP RI	Pentachlorophenol	0.24 J	mg/kg	0.24
Upper creek	Integral RI	SB-11	Yes	LSP0275	2/11/2006	1.0	2.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1 UJ	mg/kg	0.5
Upper creek	Integral RI	SB-22	Yes	LSP0324	2/14/2006	25.5	27	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.1 UJ	mg/kg	0.05
Upper creek	Integral RI	SB-22	Yes	LSP0325	2/14/2006	27	28.5	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.064 J	mg/kg	0.064
Upper creek	Integral RI	SB-22	Yes	LSP0326	2/14/2006	28.5	29.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-22	Yes	LSP0327	2/14/2006	29.6	30	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.098 J	mg/kg	0.098
Upper creek	Integral RI	SB-22	Yes	LSP0328	2/14/2006	30	31	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14	mg/kg	0.14
Upper creek	Integral RI	SB-29	Yes	LSP0474	4/6/2006	10.0	10.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.32 J	mg/kg	0.32
Upper creek	Integral RI	SB-29	Yes	LSP0464	4/6/2006	5.0	5.5	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.38	mg/kg	0.38
Upper creek	Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1.1	mg/kg	1.1
Upper creek	Integral RI	SB-31	Yes	LSP0514	4/7/2006	10.2	11.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.1 UJ	mg/kg	0.05
Upper creek	Integral RI	SB-31	Yes	LSP0509	4/7/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.11	mg/kg	0.11
Upper creek	Integral RI	SB-31	Yes	LSP0512	4/7/2006	9.6	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1	mg/kg	1
Upper creek	Integral RI	SB-31	Yes	LSP0511	4/7/2006	9.0	9.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	2.1	mg/kg	2.1
	Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0	tı.	Subsurface Soil	LSP RI	Pentachlorophenol	6.3	mg/kg	6.3

Ecological Indicator Soil Concentration for Plant Protection mg/kg ORNL Phytotoxicity Benchmark 3 mg/kg Shrew Soil Benchmark (HQ-LOAEL = 1) 3.3 mg/kg Ecological Indicator Soil Conc. for Wildlife Protection 4.5 mg/kg Ecological Indicator Soil Conc. for Soil Biota Protection 6 mg/kg ORNL Earthworm Benchmark 6 mg/kg 67 Robin Soil Benchmark (HQ-LOAEL = 1) mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

- 1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.
- 2. RA (Risk Assessment) Value = Undetected results are included in this column at 0.5 times the reported quantitation limit.

## Key:

bgs = below ground surface

Available PCP screening values (see Table SV-2 for notes on applicability):

Table ECO-5. Total PAH Results for Soil at Little Squalicum Park<sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Upper Depth	Lower Depth	Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
General Site	OESER_RI	RES-47A	Yes	99224036	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.7157	J	mg/kg
General Site	OESER_RI	RES-48	Yes	99224034	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.312	U	mg/kg
General Site	OESER_RI	RES-49	Yes	99224035	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.5703	J	mg/kg
General Site	OESER_RI	SP07	Yes	99070656	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	18.971	J	mg/kg
Historical creek	Integral RI	TP-06	Yes	LSP0048	11/8/2005	4.0	4.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	33.066	J	mg/kg
Historical creek	Integral RI	TP-06	Yes	LSP0047	11/8/2005	3.0	4.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	82.184	J	mg/kg
Historical creek	Integral RI	TP-06	Yes	LSP0044	11/8/2005	0.0	1.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	118.96	J	mg/kg
Historical creek	Integral RI	TP-06	Yes	LSP0046	11/8/2005	2.0	3.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	1012.2		mg/kg
Historical creek	Integral RI	TP-06	Yes	LSP0045	11/8/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	3394.7		mg/kg
Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	692.285	J	mg/kg
Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	337.03		mg/kg
Historical creek	Integral RI	TP-21	Yes	LSP0102	11/17/2005	0.0	2.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	18.7835		mg/kg
Illinois Street	Integral RI	SB-42	No	LSP0685	1/29/2007	36.5	38.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	24.01		mg/kg
Landfill	Integral RI	TP-23	Yes	LSP0110	1/31/2006	3.5	4.0	ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	0.3655	J	mg/kg
Landfill	Integral RI	TP-23	Yes	LSP0108	1/31/2006	0.0	2.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	0.983	J	mg/kg
Lower creek	Ecology2003	LSC-S1	Yes	3394047	9/25/2003	0.0	0.0		Surface Soil	Ecology2003	TPAHs (ND = 1/2 DL)	27.249	J	mg/kg
Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	4.4975	J	mg/kg
Lower creek	Integral RI	SB-20	Yes	LSP0271	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	6.66	J	mg/kg
South Slope	OESER_RI	RES-43	Yes	99224021	5/25/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.6378	J	mg/kg
South Slope	OESER_RI	RES-46	Yes	99224022	5/25/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.8768	J	mg/kg
South Slope	OESER_RI	B-AA2	Yes	99070532	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.1116	J	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070533	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.0844	J	mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.0564	J	mg/kg
South Slope	OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.0886		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070536	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.05925		mg/kg
South Slope	OESER RI	B-AA2	Yes	99070587	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.023	U	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070589	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.025	UJ	mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070591	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.025	UJ	mg/kg
South Slope	OESER_RI	B-BB3	Yes	99070596	8/6/1999	2.0	4.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.025	U	mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070593	8/6/1999	4.0	6.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.022	U	mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070595	8/6/1999	18.0	20.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0210		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070597	8/6/1999	18.0	20.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0319	J	
Upper creek	OESER_RI	MWLSC04	Yes	99070539	8/2/1999	12.0	14.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.02	U	mg/kg
Upper creek	OESER_RI	MWLSC04	Yes	99070538	8/2/1999	4.0	6.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.021	U	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070511	8/5/1999	0.0	0.2	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.1827	J	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2	1	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.43675	J	mg/kg
Upper creek	OESER_RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.0816	J	mg/kg
Upper creek	OESER_RI	MWLSC04	Yes	99070514	8/5/1999	0.0	0.5	ft	Surface Soil	RI	TPAHs (ND = 1/2 DL)	1.1447	J	mg/kg
Upper creek	OESER_RI	TT01-B	Yes	99070647	8/5/1999	6.0	6.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0398	J	mg/kg
Upper creek	OESER_RI	TT01-BW	Yes	99070649	8/5/1999	2.5	2.5		Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.019		mg/kg
Upper creek	OESER_RI	TT01-SW	Yes	99070648	8/5/1999	4.0	4.0	ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.1508	J	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070540	8/6/1999	10.0	12.0		Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.021		mg/kg
Upper creek	OESER_RI	SP01	Yes	99070650	8/6/1999	0.0	0.5		Surface Soil	RI	TPAHs (ND = 1/2 DL)	63.604		mg/kg
Upper creek	OESER RI	SP02	Yes	99070651	8/6/1999	0.0	0.5	1	Surface Soil	RI	TPAHs (ND = 1/2 DL)	956.4		mg/kg
Upper creek	OESER_RI	SP03	Yes	99070652	8/6/1999	0.0	0.5		Surface Soil	RI	TPAHs (ND = 1/2 DL)	32.7025		mg/kg
Upper creek	OESER_RI	SP04	Yes	99070653	8/6/1999	0.0	0.5	1	Surface Soil	RI	TPAHs (ND = 1/2 DL)	0.022		mg/kg
	OESER_RI	SP05	Yes	99070654	8/6/1999	0.0	0.5		Surface Soil	RI	TPAHs (ND = 1/2 DL)	8.5847	J	mg/kg
Upper creek								1						

Upper creek	OESER_RI	MWLSC01	Yes	99070541	8/6/1999	18.0	20.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0240 U	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070542	8/6/1999	34.0	36.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0502 J	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070545	8/7/1999	10.0	12.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.021 U	mg/kg
Upper creek	OESER_RI	MWLSC03	Yes	99070543	8/7/1999	28.0	30.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0359 J	mg/kg
Upper creek	OESER_RI	MWLSC03	Yes	99070544	8/7/1999	32.0	34.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0339 J	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070545	8/7/1999	22.0	24.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0220 U	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070546	8/7/1999	30.0	32.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.0367	mg/kg
Upper creek	Ecology2003	LSC-S2	Yes	3394048	9/25/2003	0.0	0.0	Surface Soil	Ecology2003	TPAHs (ND = 1/2 DL)	10.799 J	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0176	2/6/2006	6.0	7.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	99.92	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0179	2/6/2006	9.0	10.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	350.51	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	809.01	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0178	2/6/2006	8.0	9.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	1172.7	mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0191	2/7/2006	6.0	7.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	7.2105 J	mg/kg
Upper creek	Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	370.34	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0 ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	82.8615 J	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0219	2/8/2006	4.0	5.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	0.77 J	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0220	2/8/2006	5.0	6.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	3.835	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0223	2/8/2006	9.0	10.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	12.9515 J	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0222	2/8/2006	8.0	9.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	41.084	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0221	2/8/2006	6.0	7.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	83.982	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0226	2/9/2006	10.0	11.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	6.2715 J	mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0274	2/11/2006	0.0	1.0 ft	Surface Soil	LSP RI	TPAHs (ND = 1/2 DL)	686.9955 J	mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0275	2/11/2006	1.0	2.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	2067.56 J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0328	2/14/2006	30.0	31.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.1615 J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0325	2/14/2006	27.0	28.5 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	104.4400	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0327	2/14/2006	29.6	30.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.5950 J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0324	2/14/2006	25.5	27.0 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	0.2280 J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0326	2/14/2006	28.5	29.6 ft	Subsurface Soil	RI	TPAHs (ND = 1/2 DL)	41.9365	mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0464	4/6/2006	5.0	5.5 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	12.72 J	mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	452.08	mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0474	4/6/2006	10.0	10.6 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	602.98	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0509	4/7/2006	7.0	8.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	0.352 J	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0514	4/7/2006	10.2	11.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	2.772 J	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0512	4/7/2006	9.6	10.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	135.5	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0511	4/7/2006	9.0	9.6 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	452.81	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0 ft	Subsurface Soil	LSP RI	TPAHs (ND = 1/2 DL)	1519.6	mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

## Key:

bgs = below ground surface

PAH = polycyclic aromatic hydrocarbon

## Available PAH screening values (see Table SV-2 for notes on applicability):

 Ecological Indicator Soil Concentration for BaP, Wildlife Protection
 12
 mg/kg

 Shrew Soil Benchmark (HQ-LOAEL = 1)
 13.6
 mg/kg

 ORNL Phytotoxicity Benchmark for Acenaphthalene
 20
 mg/kg

 ORNL Earthworm Benchmark for Fluorene.
 30
 mg/kg

 Robin Soil Benchmark (HQ-LOAEL = 1)
 408
 mg/kg

Table ECO-6. Dioxin/Furan Results (as Mammalian 2.3,7,8-TCDD TEQ) for at Little Squalicum Park<sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Upper Depth	Lower Depth	Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
General Site	OESER_RI	RES-47A	Yes	99224036	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	2.55E-06	6	mg/kg
General Site	OESER_RI	RES-48	Yes	99224034	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	6.60E-06	6	mg/kg
General Site	OESER_RI	RES-49	Yes	99224035	5/26/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	5.80E-06	6	mg/kg
General Site	OESER_RI	SP07	Yes	99070656	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.88E-03	3	mg/kg
Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.33E-03	J	mg/kg
Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	3.59E-04	J	mg/kg
Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.13E-03	J	mg/kg
Lower creek	Integral RI	SB-20	Yes	LSP0271	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.58E-03	J	mg/kg
South Slope	OESER_RI	RES-43	Yes	99224021	5/25/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	7.81E-05	5	mg/kg
South Slope	OESER_RI	RES-46	Yes	99224022	5/25/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	5.13E-06	J	mg/kg
South Slope	OESER_RI	B-AA2	Yes	99070532	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	1.08E-05	5	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070533	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	7.25E-06	3	mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	9.44E-06	6	mg/kg
South Slope	OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	6.86E-06	3	mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070536	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	4.69E-06	6	mg/kg
South Slope	OESER_RI	B-AA2	Yes	99070587	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TEQDF 0.5M05	5.61E-06	6	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070589	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TEQDF 0.5M05	4.11E-06	U	mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070591	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.13E-05	U	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070590	8/5/1999	18	20	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.86E-05	U	mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070588	8/5/1999	36	38	ft	Subsurface Soil	RI	TEQDF 0.5M05	2.24E-06		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070593	8/6/1999	4.0	6.0	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.45E-05	U	mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070594	8/6/1999	16	18	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.25E-05	U	mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070595	8/6/1999	18	20	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.05E-05	U	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070511	8/5/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	2.94E-05	5	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	2.36E-05	5	mg/kg
Upper creek	OESER_RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.40E-05	5	mg/kg
Upper creek	OESER_RI	MWLSC04	Yes	99070514	8/5/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.27E-04		mg/kg
Upper creek	OESER_RI	TT01-BW	Yes	99070649	8/5/1999	2.5	2.5	ft	Subsurface Soil	RI	TEQDF 0.5M05	8.50E-07	,	mg/kg
Upper creek	OESER_RI	SP01	Yes	99070650	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.93E-04		mg/kg
Upper creek	OESER_RI	SP02	Yes	99070651	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.37E-03	3	mg/kg
Upper creek	OESER_RI	SP03	Yes	99070652	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	9.87E-04	ı	mg/kg
Upper creek	OESER_RI	SP04	Yes	99070653	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.49E-06	6	mg/kg
Upper creek	OESER_RI	SP05	Yes	99070654	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	4.01E-04	ı	mg/kg
Upper creek	OESER_RI	SP06	Yes	99070655	8/6/1999	0.0	0.5		Surface Soil	RI	TEQDF 0.5M05	3.32E-04	J	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070541	8/6/1999	18	20	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.38E-06	3	mg/kg
Upper creek	OESER_RI	MWLSC03	Yes	99070544	8/7/1999	32	34		Subsurface Soil	RI	TEQDF 0.5M05	1.39E-05	1	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	2.32E-05	j J	mg/kg
Upper creek	Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0		Subsurface Soil	LSP RI	TEQDF 0.5M05	3.90E-04	1	mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0		Surface Soil	LSP RI	TEQDF 0.5M05	1.68E-04		mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3		Subsurface Soil	LSP RI	TEQDF 0.5M05	1.04E-04	1	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0		Subsurface Soil	LSP RI	TEQDF 0.5M05	4.04E-04		mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

## Notes:

1. Mammalian TEQ data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

## Key:

bgs = below ground surface

TCDD = Tetrachlorodibenzo-p-dioxin

TEQ = toxic equivalent concentration

## Available TCDD screening values (see Table SV-2 for notes on applicability):

 Ecological Indicator Soil Conc., Wildlife Protection
 2.0E-06
 mg/kg

 Shrew Soil Benchmark (HQ-LOAEL = 1)
 2.5E-05
 mg/kg

 Robin Soil Benchmark (HQ-LOAEL = 1)
 1.4E-04
 mg/kg

 Earthworm Benchmark.
 0.5
 mg/kg

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Table ECO-7.	Pentachloropl	nenol Resu	ılts for S	ediment at	Little Squalic	cum Park¹.								RA Value <sup>2</sup>
Site Area	Event	Location	On Site	Sample ID	Sampling Dat I	Jpper Depth	Lower Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units	(mg/kg)
Beach	OESER_RI	OS01	Yes	95352500	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	0.0391	J	mg/kg	0.0391
Historical creek	Integral RI	SB-35	Yes	LSP0545	4/10/2006	0.0	1.0 ft	Surface Sediment	LSP RI	Pentachlorophenol	0.28	UJ	mg/kg	0.14
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1.0	1.8 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	7.3		mg/kg	7.3
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0.0	0.8 ft	Surface Sediment	LSP RI	Pentachlorophenol	7.9		mg/kg	7.9
Historical creek	Integral RI	SB-37	Yes	LSP0553	4/10/2006	1.2	2.0 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	0.15	J	mg/kg	0.15
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0.0	1.2 ft	Surface Sediment	LSP RI	Pentachlorophenol	1.3		mg/kg	1.3
Historical creek	Integral RI	SB-34	Yes	LSP0555	4/11/2006	0.0	1.1 ft	Surface Sediment	LSP RI	Pentachlorophenol	0.28	UJ	mg/kg	0.14
Historical creek	Integral RI	SB-38	Yes	LSP0558	4/11/2006	1.0	1.9 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	0.14	UJ	mg/kg	0.07
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0.0	1.0 ft	Surface Sediment	LSP RI	Pentachlorophenol	3.6		mg/kg	3.6
Historical creek	Integral RI	SB-39	Yes	LSP0563	4/11/2006	0.0	0.7 ft	Surface Sediment	LSP RI	Pentachlorophenol	2.7		mg/kg	2.7
Lower creek	OESER_RI	OS02	Yes	95352501	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	0.869	J	mg/kg	0.869
Lower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.0037	J	mg/kg	0.0037
Lower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.033		mg/kg	0.033
Lower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	2	J	mg/kg	2
Lower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.024		mg/kg	0.024
Lower creek	Ecology2003	LSC-01	Yes	3394040	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	0.617		mg/kg	0.617
Lower creek	Ecology2003	LSC-02	Yes	3394041	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	1.26	J	mg/kg	1.26
Lower creek	Ecology2003	LSC-03	Yes	3394042	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	4.33	J	mg/kg	4.33
Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1.0	2.0 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	3.2		mg/kg	3.2
Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0.0	1.0 ft	Surface Sediment	LSP RI	Pentachlorophenol	4.5		mg/kg	4.5
Lower creek	Integral RI	SB-10	Yes	LSP0181	2/6/2006	2.0	3.0 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	0.054	J	mg/kg	0.054
Lower creek	Integral RI	SB-19	Yes	LSP0263	2/10/2006	0.0	1.0 ft	Surface Sediment	LSP RI	Pentachlorophenol	0.58		mg/kg	0.58
Lower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1.0	2.0 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	0.71		mg/kg	0.71
Lower creek	Integral RI	SB-19	Yes	LSP0253	2/10/2006	2.0	3.0 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	0.81		mg/kg	0.81
Lower creek	Integral RI	SB-19	Yes	LSP0254	2/10/2006	3.0	3.6 ft	Subsurface Sediment	LSP RI	Pentachlorophenol	1.6		mg/kg	1.6
Upper creek	OESER_RI	OS03	Yes	95352502	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	1.75		mg/kg	1.75
Upper creek	OESER_RI	OS04	Yes	95352503	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	0.875	J	mg/kg	0.875
Upper creek	OESER_RI	OS05	Yes	95352504	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	0.563	J	mg/kg	0.563
Upper creek	OESER_RI	OS06	Yes	95352505	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	2.17		mg/kg	2.17
Upper creek	OESER_RI	SD05	Yes	99070524	7/28/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.056		mg/kg	0.056
Upper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	1.28	J	mg/kg	1.28
Upper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.015		mg/kg	0.015
Upper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.16		mg/kg	0.16
Upper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	1.1		mg/kg	1.1
Upper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	2.9		mg/kg	2.9
Upper creek	Ecology2003	LSC-04	Yes	3394043	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	2.19	J	mg/kg	2.19
Upper creek	Ecology2003	LSC-06	Yes	3394045	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	4.27	J	mg/kg	4.27
Upper creek	Integral RI	LSC Bank	Yes	LSP0051	11/7/2005	0.0	0.5 ft	Surface Sediment	LSP RI	Pentachlorophenol	1.8	J	mg/kg	1.8
Wetlands	OESER_RI	OS07	Yes	95352506	1/1/1996	0.0	0.5 ft	Surface Sediment	ESI	Pentachlorophenol	0.926		mg/kg	0.46
Wetlands	OESER_RI	SD11	Yes	99070530	7/29/1999	0.0	0.5 ft	Surface Sediment	RI	Pentachlorophenol	0.05		mg/kg	0.02
Wetlands	Ecology2003	LSC-05	Yes	3394044	9/25/2003	0.0	0.0	Surface Sediment	Ecology2003	Pentachlorophenol	1.27		mg/kg	1.2

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

#### Key:

bgs = below ground surface

## Available PCP screening values (see Table SV-2 for notes on applicability):

Washington State Marine Sediment Quality Standard (SQS)0.36mg/kgWashington State Marine Cleanup Sceening Level (CSL)0.69mg/kgSwallow Sediment Benchmark (HQ-LOAEL = 1)39mg/kg

Ecology and Environment, Inc.

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<sup>1.</sup> Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

<sup>2.</sup> RA (Risk Assessment) Value = Undetected results are included in this column at 0.5 times the reported quantitation limit.

Table ECO-8. Low Molecular Weight PAH Results for Sediment at Little Squalicum Park <sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Upper Depth	Lower Depth	Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
Beach	OESER_RI	OS01	Yes	95352500	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	0.2793	J	mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0545	4/10/2006	0	1.0	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.605		mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1	1.8	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	8.647	J	mg/kg
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0	0.8	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	4.98		mg/kg
Historical creek	Integral RI	SB-37	Yes	LSP0553	4/10/2006	1.2	2	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.207	J	mg/kg
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0	1.2	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	1.035	J	mg/kg
Historical creek	Integral RI	SB-34	Yes	LSP0555	4/11/2006	0	1.1	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.655		mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0558	4/11/2006	1	1.9	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.237	J	mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0	1.0	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	10.845	J	mg/kg
Historical creek	Integral RI	SB-39	Yes	LSP0563	4/11/2006	0	0.7	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	4.272	J	mg/kg
Lower creek	OESER_RI	OS02	Yes	95352501	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	1.815	J	mg/kg
Lower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.009		mg/kg
Lower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	3.143		mg/kg
Lower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.4073		mg/kg
Lower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.039		mg/kg
Lower creek	Ecology2003	LSC-01	Yes	3394040	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	1.1165	J	mg/kg
Lower creek	Ecology2003	LSC-02	Yes	3394041	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	4.1315	J	mg/kg
Lower creek	Ecology2003	LSC-03	Yes	3394042	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	105.236	J	mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1	2	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	2.846		mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0	1.0	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	3.4055		mg/kg
Lower creek	Integral RI	SB-10	Yes	LSP0181	2/6/2006	2	3	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.165		mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0263	2/10/2006	0	1.0	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	0.9465	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1	2	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	4.668	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0253	2/10/2006	2	3	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	23.807		mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0254	2/10/2006	3	3.6	ft	Subsurface Sediment	LSP RI	LPAH (ND = 1/2 DL)	49.25		mg/kg
Upper creek	OESER_RI	OS03	Yes	95352502	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	4.777	J	mg/kg
Upper creek	OESER_RI	OS04	Yes	95352503	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	10.616		mg/kg
Upper creek	OESER_RI	OS05	Yes	95352504	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	8.432		mg/kg
Upper creek	OESER_RI	OS06	Yes	95352505	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	2.19	J	mg/kg
Upper creek	OESER_RI	SD05	Yes	99070524	7/28/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.1952		mg/kg
Upper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	1.3075		mg/kg
Upper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.159		mg/kg
Upper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.3682		mg/kg
Upper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.2346		mg/kg
Upper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	1.346		mg/kg
Upper creek	Ecology2003	LSC-04	Yes	3394043	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	2.488		mg/kg
Upper creek	Ecology2003	LSC-06	Yes	3394045	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	3.902		mg/kg
Upper creek	Integral RI	LSC Bank	Yes	LSP0051	11/7/2005	0	0.5	ft	Surface Sediment	LSP RI	LPAH (ND = 1/2 DL)	651.105		mg/kg
Wetlands	OESER_RI	OS07	Yes	95352506	1/1/1996	0	0.5	ft	Surface Sediment	ESI	LPAH (ND = 1/2 DL)	0.185	U	mg/kg
Wetlands	OESER_RI	SD11	Yes	99070530	7/29/1999	0	0.5	ft	Surface Sediment	RI	LPAH (ND = 1/2 DL)	0.048		mg/kg
Wetlands	Ecology2003	LSC-05	Yes	3394044	9/25/2003	0	0.0		Surface Sediment	Ecology2003	LPAH (ND = 1/2 DL)	0.558	J	mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

## Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

#### Key:

bgs = below ground surface

PAH = polycyclic aromatic hydrocarbon

TOC = total organic carbon

## Available LPAH screening values (see Table SV-2 for notes on applicability):

 Site-Specific No Effect Concentration.
 3.1
 mg/kg

 Freshwater Sediment Lowest Apparent Effects Level (LAET)
 6.6
 mg/kg

 Freshwater Sediment 2nd Lowest Apparent Effects Level (2LAET)
 9.2
 mg/kg

 Marine Sediment Quality Standard (SQS)
 18.1
 mg/kg

 Marine Sediment Cleanup Screening Level (CSL)
 38.2
 mg/kg

Table ECO-9. High Molecular Weight PAH Results for Sediment at Little Squalicum Park<sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Dat	Upper Depth	Lower Depth	Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
Beach	OESER_RI	OS01	Yes	95352500	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	0.6001	J	mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0545	4/10/2006	0	1	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	2.21		mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1	1.8	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	62.24		mg/kg
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0	0.8	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	42.09		mg/kg
Historical creek	Integral RI	SB-37	Yes	LSP0553	4/10/2006	1.2	2	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	1.556	J	mg/kg
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0	1.2	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	5.65		mg/kg
Historical creek	Integral RI	SB-34	Yes	LSP0555	4/11/2006	0	1.1	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	3.12		mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0558	4/11/2006	1	1.9	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	6.2		mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0	1	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	343.3		mg/kg
Historical creek	Integral RI	SB-39	Yes	LSP0563	4/11/2006	0	0.7	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	47.33		mg/kg
Lower creek	OESER_RI	OS02	Yes	95352501	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	13.998		mg/kg
Lower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	0.0734	J	mg/kg
Lower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	18.977	J	mg/kg
Lower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	0.817	J	mg/kg
Lower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	0.43315	J	mg/kg
Lower creek	Ecology2003	LSC-01	Yes	3394040	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	5.136		mg/kg
Lower creek	Ecology2003	LSC-02	Yes	3394041	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	21.403	J	mg/kg
Lower creek	Ecology2003	LSC-03	Yes	3394042	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	324.02	J	mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1	2	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	19.14	J	mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0	1	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	19.745	J	mg/kg
Lower creek	Integral RI	SB-10	Yes	LSP0181	2/6/2006	2	3	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	2.366	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0263	2/10/2006	0	1	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	8.067		mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1	2	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	20.31	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0253	2/10/2006	2	3	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	142.85		mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0254	2/10/2006	3	3.6	ft	Subsurface Sediment	LSP RI	HPAH (ND = 1/2 DL)	388.7		mg/kg
Upper creek	OESER_RI	OS03	Yes	95352502	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	31.07		mg/kg
Upper creek	OESER_RI	OS04	Yes	95352503	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	63.08		mg/kg
Upper creek	OESER_RI	OS05	Yes	95352504	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	88.26		mg/kg
Upper creek	OESER_RI	OS06	Yes	95352505	1/1/1996	0	0.5	ft	Surface Sediment	ESI	HPAH (ND = 1/2 DL)	11.243		mg/kg
Upper creek	OESER_RI	SD05	Yes	99070524	7/28/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	1.7	J	mg/kg
Upper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	9.44305	J	mg/kg
Upper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	1.524	J	mg/kg
Upper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	4.2787	J	mg/kg
Upper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	0.6116	J	mg/kg
Upper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0	0.5	ft	Surface Sediment	RI	HPAH (ND = 1/2 DL)	14.36	J	mg/kg
Upper creek	Ecology2003	LSC-04	Yes	3394043	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	13.856	J	mg/kg
Upper creek	Ecology2003	LSC-06	Yes	3394045	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	18.166	J	mg/kg
Upper creek	Integral RI	LSC Bank	Yes	LSP0051	11/7/2005	0	0.5	ft	Surface Sediment	LSP RI	HPAH (ND = 1/2 DL)	858.7		mg/kg
Wetlands	OESER_RI	OS07	Yes	95352506	1/1/1996	0	0.5		Surface Sediment	ESI	HPAH (ND = 1/2 DL)	0.185	U	mg/kg
Wetlands	OESER RI	SD11	Yes	99070530	7/29/1999	0	0.5		Surface Sediment	RI	HPAH (ND = 1/2 DL)	0.1145		mg/kg
Wetlands	Ecology2003	LSC-05	Yes	3394044	9/25/2003	0	0		Surface Sediment	Ecology2003	HPAH (ND = 1/2 DL)	1.231	J	mg/kg

Source: Ecology and Environment, Inc. (E&E), November 2007.

#### Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

## Key:

bgs = below ground surface

PAH = polycyclic aromatic hydrocarbons

## Available HPAH screening values (see Table SV-2 for notes on applicability):

 Site-Specific No Effect Concentration.
 18.2
 mg/kg

 Freshwater Sediment Lowest Apparent Effects Level (LAET)
 31.6
 mg/kg

 Marine Sediment Quality Standard (SQS)
 47
 mg/kg

 Freshwater Sediment 2nd Lowest Apparent Effects Level (2LAET)
 54.8
 mg/kg

 Marine Sediment Cleanup Screening Level (CSL)
 260
 mg/kg

Ecology and Environment, Inc.

3/6/2008

Table ECO-10. Dioxin/Furan Results (as avian 2,3,7,8-TCDD TEQ) for Sediment at Little Squalicum Park<sup>1</sup>.

Site Area	Event	Location	On Site	Sample ID	Sampling Date	Upper Depth	Lower Depth I	Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0	1.2 f	ft	Surface Sediment	LSP RI	TEQDF B1	6.91E-0	4 J	mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1	1.8 f	ft	Subsurface Sediment	LSP RI	TEQDF B1	9.80E-0	4 J	mg/kg
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0	0.8 f	ft	Surface Sediment	LSP RI	TEQDF B1	1.37E-0	3 J	mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0	1 f	ft	Surface Sediment	LSP RI	TEQDF B1	2.57E-0	4 J	mg/kg
ower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	6.37E-0	6	mg/kg
_ower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	1.41E-0	5	mg/kg
ower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	8.24E-0	5	mg/kg
ower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	9.30E-0	5	mg/kg
ower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1	2 f	ft	Subsurface Sediment	LSP RI	TEQDF B1	3.52E-0	3 J	mg/kg
ower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0	1 f	ft	Surface Sediment	LSP RI	TEQDF B1	4.44E-0	3 J	mg/kg
ower creek	Integral RI	SB-19	Yes	LSP0254	2/10/2006	3	3.6 f	ft	Subsurface Sediment	LSP RI	TEQDF B1	5.74E-0	4 J	mg/kg
ower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1	2.0 f	ft	Subsurface Sediment	LSP RI	TEQDF B1	7.33E-0	4 J	mg/kg
Jpper creek	OESER_RI	SD05	Yes	99070524	7/28/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	1.52E-0	5	mg/kg
Jpper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	8.56E-0	6	mg/kg
Jpper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	3.22E-0	5	mg/kg
Jpper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	8.44E-0	5	mg/kg
Jpper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	9.21E-0	5	mg/kg
Jpper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0	0.5 f	ft	Surface Sediment	RI	TEQDF B1	3.70E-0	4	mg/kg
Vetlands	OESER_RI	SD11	Yes	99070530	7/29/1999	0	0.5 f	it	Surface Sediment	RI	TEQDF B1	5.33E-0	6	mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

## Key:

bgs = below ground surface

TCDD = tetrachlorodibenzo-p-dioxin

TEQ = toxic equivalent concentration

# Available TCDD screening values (see Table SV-2 for notes on applicability):

 NOAA SQUIRT Benchmark.
 4.30E-05
 mg/kg

 Swallow Sediment Benchmark (HQ-LOAEL =1)
 4.32E-04
 mg/kg

Site Area		Location	On Site	Comple ID	Compling Data	cum Park <sup>1</sup> .	Course	Analyta	VALUE occur	Ouglifier	Unite conv	(ug/L)
D	Event	Location			Sampling_Date		Source	Analyte	VALUE_conv	Qualifier	Units_conv	(ug/L)
	OESER_RI	OS01		95372614		Surface Water	ESI ESI	Pentachlorophenol	2.2		ug/l	1.1
	OESER_RI	OS02		95372616		Surface Water		Pentachlorophenol	2.2	U	ug/l	
Lower creek	OESER_RI	SW-01		99314150		Surface Water	RI	Pentachlorophenol	0.055		ug/l	0.055
	OESER_RI	SW-01		99504000		Surface Water	RI	Pentachlorophenol	14		ug/l	14
	OESER_RI	SW-09	-	99504002		Surface Water	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Lower creek	Integral RI	SW-01	Yes	LSP0001		Surface Water	LSP RI	Pentachlorophenol	13		ug/l	13
	Integral RI	SW-09	Yes	LSP0002		Surface Water	LSP RI	Pentachlorophenol	15		ug/l	15
Lower creek	Integral RI	SW-01	Yes	LSP0583		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Lower creek	Integral RI	SW-09	Yes	LSP0584		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
- ' '	OESER_RI	OS03		95372612		Surface Water	ESI	Pentachlorophenol	2.2	U	ug/l	1.1
• •	OESER_RI	256		97040256	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	1.5		ug/l	1.5
Upper creek	OESER_RI	320	Yes	97040320	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	17	J	ug/l	17
Upper creek	OESER_RI	343	Yes	97040343	1/1/1998	Surface Water	RA Phase II	Pentachlorophenol	0.52	UJ	ug/l	0.26
Upper creek	OESER_RI	SEEP-1	Yes	99244027	6/10/1999	Seep	RI	Pentachlorophenol	0.48	U	ug/l	0.24
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	Pentachlorophenol	0.063		ug/l	0.063
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	Pentachlorophenol	0.05	U	ug/l	0.025
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	Pentachlorophenol	0.027	JL	ug/l	0.027
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	Pentachlorophenol	0.042	JL	ug/l	0.042
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	Pentachlorophenol	0.025	UJK	ug/l	0.013
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999		RI	Pentachlorophenol	0.024	UJK	ug/l	0.012
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	Pentachlorophenol	8.5		ug/l	8.5
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	Pentachlorophenol	7.2		ug/l	7.2
• •	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	Pentachlorophenol	21		ug/l	21
• •	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	Pentachlorophenol	0.17		ug/l	0.170
	OESER RI	SW-08	Yes	99504856	12/11/1999		RI	Pentachlorophenol	0.33		ug/l	0.33
-	Integral RI	SW-04	Yes	LSP0003		Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
Upper creek	Integral RI	SW-05	Yes	LSP0004		Surface Water	LSP RI	Pentachlorophenol	140		ug/l	140
Upper creek	Integral RI	SW-06	Yes	LSP0006		Surface Water	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.46
• •	Integral RI	SW-10	No	LSP0008		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Upper creek	Integral RI	SW-04	Yes	LSP0585		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Upper creek	Integral RI	SW-05	Yes	LSP0587		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
• •	Integral RI	SW-06	Yes	LSP0586		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
Upper creek	Integral RI	SW-10	No	LSP0590		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
• •	Integral RI	SW-11	Yes	LSP0599		Surface Water	LSP RI	Pentachlorophenol	0.91		ug/l	0.46
• •	OESER RI	OS07		95352507		Surface Water	ESI	Pentachlorophenol	2.1		ug/l	1.1
	OESER_RI	SW-07	Yes			Surface Water	RI		0.025		·	0.013
Wetlands		SW-07		99314157 99504862			RI	Pentachlorophenol	0.025	OJN	ug/l	0.013
	OESER_RI					Surface Water		Pentachlorophenol			ug/l	
Wetlands Wetlands	Integral RI Integral RI	SW-07 SW-07	Yes Yes	LSP0007 LSP0589		Surface Water Surface Water	LSP RI	Pentachlorophenol Pentachlorophenol	0.91 0.91		ug/l ug/l	0.46

Source: Ecology and Environment, Inc. (E&E), March 2008.

# Notes:

- 1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.
- 2. RA Value = Undetected results are included in this column at 0.5 times the reported quantitation limit.

#### Key:

EPA = (United States) Environmental Protection Agency

RA = Risk Assessment

Available PCP screening values (see Table SV-1 notes on applicability):

NAWQC, Water + Organism Consumption, 10-6 Cancer Risk0.27ug/LEPA Region 6 RBC - Residential0.56ug/LMTCA Method B Surface Water Carcinogen4.91ug/LNAWQC, Water + Organism Consumption, 10-4 Cancer Risk27ug/L

Table HH-2. Carcinogenic PAH Results (as Benzolalpyrene Equivalent Concentration) for Surface Water at Little Squalicum Park

Site_Area	Event	Location	On_Site	Sample_ID	Sampling_Date	Matrix	Source	Analyte	VALUE_conv	Qualifier	Units_conv
Beach	OESER_RI	OS01	Yes	95372614	1/1/1996	Surface Water	ESI	TEQBAP (ND = 1/2 DL)	0.2295	J	ug/l
Lower creek	OESER_RI	OS02	Yes	95372616	1/1/1996	Surface Water	ESI	TEQBAP (ND = 1/2 DL)	0.44	U	ug/l
Lower creek	OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.03925		ug/l
Lower creek	OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.01717		ug/l
Lower creek	OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.0047	U	ug/l
Lower creek	Integral RI	SW-01	Yes	LSP0001	11/1/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Lower creek	Integral RI	SW-09	Yes	LSP0002	11/1/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Lower creek	Integral RI	SW-01	Yes	LSP0583	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Lower creek	Integral RI	SW-09	Yes	LSP0584	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	OESER_RI	OS03	Yes	95372612	1/1/1996	Surface Water	ESI	TEQBAP (ND = 1/2 DL)	0.45	U	ug/l
Upper creek	OESER_RI	256	Yes	97040256	1/1/1998	Surface Water	RA Phase II	TEQBAP (ND = 1/2 DL)	0.06995		ug/l
Upper creek	OESER_RI	320	Yes	97040320	1/1/1998	Surface Water	RA Phase II	TEQBAP (ND = 1/2 DL)	0.0206		ug/l
Upper creek	OESER_RI	343	Yes	97040343	1/1/1998	Surface Water	RA Phase II	TEQBAP (ND = 1/2 DL)	0.013	UJ	ug/l
Upper creek	OESER_RI	SEEP-1	Yes	99244027	6/10/1999	Seep	RI	TEQBAP (ND = 1/2 DL)	0.0048	U	ug/l
Upper creek	OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.017448		ug/l
Upper creek	OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	TEQBAP (ND = 1/2 DL)	0.0099	U	ug/l
Upper creek	OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.007033		ug/l
Upper creek	OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.0048	U	ug/l
Upper creek	OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.0049	U	ug/l
Upper creek	OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	TEQBAP (ND = 1/2 DL)	0.009063		ug/l
Upper creek	OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.033075		ug/l
Upper creek	OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	TEQBAP (ND = 1/2 DL)	0.0047	U	ug/l
Upper creek	OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.003625		ug/l
Upper creek	OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.173135		ug/l
Upper creek	OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.019045		ug/l
Upper creek	OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	TEQBAP (ND = 1/2 DL)	0.2272		ug/l
Upper creek	Integral RI	SW-04	Yes	LSP0003	11/1/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.3555	J	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SW-04	Yes	LSP0585	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-06	Yes	LSP0586	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-10	No	LSP0590	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SW-11	Yes	LSP0599	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Wetlands	OESER_RI	OS07	Yes	95352507	1/1/1996	Surface Water	ESI	TEQBAP (ND = 1/2 DL)	0.42	U	ug/l
Wetlands	OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.0051	U	ug/l
Wetlands	OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	TEQBAP (ND = 1/2 DL)	0.0047	U	ug/l
Wetlands	Integral RI	SW-07	Yes	LSP0007	11/2/2005	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Wetlands	Integral RI	SW-07	Yes	LSP0589	4/27/2006	Surface Water	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

1. From March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

Key:

PAH = polycyclic aromatic hydrocarbon

Available carcinogenic PAH screening values (see Table SV-1 notes on applicability):

NAWQC, Water + Organisms Consumption, 10-6 Cancer Risk	0.0038	ug/L
EPA Region 6 RBC - Residential	0.0029	ug/L
MTCA Method B Surface Water Carcinogen	0.0296	ug/L
NAWQC, Water + Organisms Consumption, 10-4 Cancer Risk	0.38	ug/L

Table HH-3. Dioxin/Furan Results (as 2,3,7,8-TCDD Equivalent Concentration) for Surface Water at Little Squalicum Park<sup>1</sup>.

Event	Location	On_Site	Sample_ID	Sampling_Date	Matrix	Source	Analyte	VALUE_conv	Qualifier	Units_conv
OESER_RI	SW-01	Yes	99314150	7/26/1999	Surface Water	RI	TEQDF 0.5M05	1.60E-05		ug/l
OESER_RI	SW-01	Yes	99504000	12/6/1999	Surface Water	RI	TEQDF 0.5M05	5.10E-05		ug/l
OESER_RI	SW-09	Yes	99504002	12/6/1999	Surface Water	RI	TEQDF 0.5M05	1.83E-05	U	ug/l
OESER_RI	SW-02	Yes	99314151	7/26/1999	Surface Water	RI	TEQDF 0.5M05	2.78E-05		ug/l
OESER_RI	SW-03	Yes	99314152	7/26/1999	Spring	RI	TEQDF 0.5M05	1.91E-05	U	ug/l
OESER_RI	SW-04	Yes	99314153	7/26/1999	Surface Water	RI	TEQDF 0.5M05	1.87E-05		ug/l
OESER_RI	SW-05	Yes	99314154	7/27/1999	Surface Water	RI	TEQDF 0.5M05	1.54E-05		ug/l
OESER_RI	SW-06	Yes	99314155	7/27/1999	Surface Water	RI	TEQDF 0.5M05	3.49E-05	U	ug/l
OESER_RI	SW-08	Yes	99314158	7/27/1999	Seep	RI	TEQDF 0.5M05	1.35E-05		ug/l
OESER_RI	SW-02	Yes	99504004	12/6/1999	Surface Water	RI	TEQDF 0.5M05	4.94E-05		ug/l
OESER_RI	SW-03	Yes	99504008	12/6/1999	Spring	RI	TEQDF 0.5M05	7.36E-06		ug/l
OESER_RI	SW-04	Yes	99504006	12/6/1999	Surface Water	RI	TEQDF 0.5M05	8.86E-05		ug/l
OESER_RI	SW-05	Yes	99504858	12/11/1999	Surface Water	RI	TEQDF 0.5M05	1.17E-04		ug/l
OESER_RI	SW-06	Yes	99504860	12/11/1999	Surface Water	RI	TEQDF 0.5M05	1.27E-05		ug/l
OESER_RI	SW-08	Yes	99504856	12/11/1999	Seep	RI	TEQDF 0.5M05	3.88E-05		ug/l
Integral RI	SW-05	Yes	LSP0004	11/1/2005	Surface Water	LSP RI	TEQDF 0.5M05	5.77E-04	J	ug/l
Integral RI	SW-06	Yes	LSP0006	11/1/2005	Surface Water	LSP RI	TEQDF 0.5M05	1.70E-05	J	ug/l
Integral RI	SW-10	No	LSP0008	11/2/2005	Surface Water	LSP RI	TEQDF 0.5M05	1.63E-05	J	ug/l
Integral RI	SW-05	Yes	LSP0587	4/27/2006	Surface Water	LSP RI	TEQDF 0.5M05	1.86E-05	J	ug/l
OESER_RI	SW-07	Yes	99314157	7/27/1999	Surface Water	RI	TEQDF 0.5M05	6.37E-05	U	ug/l
OESER_RI	SW-07	Yes	99504862	12/11/1999	Surface Water	RI	TEQDF 0.5M05	1.90E-05		ug/l
	Event OESER_RI IOESER_RI IOESER_RI IOESER_RI IOESER_RI INTEGRAL RI OESER_RI	Event         Location           OESER_RI         SW-01           OESER_RI         SW-01           OESER_RI         SW-09           OESER_RI         SW-02           OESER_RI         SW-03           OESER_RI         SW-04           OESER_RI         SW-05           OESER_RI         SW-06           OESER_RI         SW-08           OESER_RI         SW-02           OESER_RI         SW-03           OESER_RI         SW-04           OESER_RI         SW-04           OESER_RI         SW-05           OESER_RI         SW-06           OESER_RI         SW-06           OESER_RI         SW-08           Integral RI         SW-05           Integral RI         SW-06           Integral RI         SW-06           Integral RI         SW-06           OESER_RI         SW-06	Event         Location         On_Site           OESER_RI         SW-01         Yes           OESER_RI         SW-01         Yes           OESER_RI         SW-09         Yes           OESER_RI         SW-02         Yes           OESER_RI         SW-03         Yes           OESER_RI         SW-04         Yes           OESER_RI         SW-05         Yes           OESER_RI         SW-06         Yes           OESER_RI         SW-08         Yes           OESER_RI         SW-08         Yes           OESER_RI         SW-02         Yes           OESER_RI         SW-03         Yes           OESER_RI         SW-04         Yes           OESER_RI         SW-05         Yes           OESER_RI         SW-05         Yes           OESER_RI         SW-06         Yes           OESER_RI         SW-08         Yes           Integral RI         SW-05         Yes           Integral RI         SW-06         Yes           Integral RI         SW-05         Yes           OESER_RI         SW-05         Yes	Event         Location         On_Site         Sample_ID           OESER_RI         SW-01         Yes         99314150           OESER_RI         SW-01         Yes         99504000           OESER_RI         SW-09         Yes         99504002           OESER_RI         SW-09         Yes         99314151           OESER_RI         SW-03         Yes         99314152           OESER_RI         SW-04         Yes         99314153           OESER_RI         SW-05         Yes         99314154           OESER_RI         SW-06         Yes         99314155           OESER_RI         SW-08         Yes         99314158           OESER_RI         SW-08         Yes         99504004           OESER_RI         SW-02         Yes         99504006           OESER_RI         SW-03         Yes         99504008           OESER_RI         SW-04         Yes         99504006           OESER_RI         SW-05         Yes         99504858           OESER_RI         SW-06         Yes         99504860           OESER_RI         SW-08         Yes         99504860           OESER_RI         SW-08         Yes	Event         Location         On_Site         Sample_ID         Sampling_Date           OESER_RI         SW-01         Yes         99314150         7/26/1999           OESER_RI         SW-01         Yes         99504000         12/6/1999           OESER_RI         SW-09         Yes         99504002         12/6/1999           OESER_RI         SW-09         Yes         99314151         7/26/1999           OESER_RI         SW-02         Yes         99314152         7/26/1999           OESER_RI         SW-03         Yes         99314153         7/26/1999           OESER_RI         SW-04         Yes         99314154         7/27/1999           OESER_RI         SW-05         Yes         99314155         7/27/1999           OESER_RI         SW-06         Yes         99314158         7/27/1999           OESER_RI         SW-08         Yes         99504004         12/6/1999           OESER_RI         SW-03         Yes         99504008         12/6/1999           OESER_RI         SW-04         Yes         99504008         12/6/1999           OESER_RI         SW-05         Yes         99504006         12/11/1999           OESER_RI <td< td=""><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water           OESER_RI         SW-03         Yes         99314152         7/26/1999         Spring           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water           OESER_RI         SW-05         Yes         99314154         7/27/1999         Surface Water           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water           OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water           OESER_RI         SW-00         Yes         99504004         12/6/1999         Surface Water           OESER_RI         SW-03         Yes         99504006         12/6/1999         Su</td><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI           OESER_RI         SW-03         Yes         99314152         7/26/1999         Spring         RI           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI           OESER_RI         SW-05         Yes         99314154         7/27/1999         Surface Water         RI           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water         RI           OESER_RI         SW-08         Yes         99504004         12/6/1999         Surface Water         RI           OESER_RI         SW-03         Yes         99504006         <t< td=""><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI</td><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.87E-05           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.35E-05           OESER_RI         SW</td><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv         Qualifier           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-03         Yes         99314152         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05 U           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.37E-05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05         3.49E-05 U</td></t<></td></td<>	Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water           OESER_RI         SW-03         Yes         99314152         7/26/1999         Spring           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water           OESER_RI         SW-05         Yes         99314154         7/27/1999         Surface Water           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water           OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water           OESER_RI         SW-00         Yes         99504004         12/6/1999         Surface Water           OESER_RI         SW-03         Yes         99504006         12/6/1999         Su	Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI           OESER_RI         SW-03         Yes         99314152         7/26/1999         Spring         RI           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI           OESER_RI         SW-05         Yes         99314154         7/27/1999         Surface Water         RI           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water         RI           OESER_RI         SW-08         Yes         99504004         12/6/1999         Surface Water         RI           OESER_RI         SW-03         Yes         99504006 <t< td=""><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI</td><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.87E-05           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.35E-05           OESER_RI         SW</td><td>Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv         Qualifier           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-03         Yes         99314152         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05 U           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.37E-05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05         3.49E-05 U</td></t<>	Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI         SW-08         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05           OESER_RI	Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-03         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05           OESER_RI         SW-04         Yes         99314154         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.87E-05           OESER_RI         SW-06         Yes         99314158         7/27/1999         Surface Water         RI         TEQDF 0.5M05         1.35E-05           OESER_RI         SW	Event         Location         On_Site         Sample_ID         Sampling_Date         Matrix         Source         Analyte         VALUE_conv         Qualifier           OESER_RI         SW-01         Yes         99314150         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.60E-05           OESER_RI         SW-01         Yes         99504000         12/6/1999         Surface Water         RI         TEQDF 0.5M05         5.10E-05           OESER_RI         SW-09         Yes         99504002         12/6/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-02         Yes         99314151         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.83E-05 U           OESER_RI         SW-03         Yes         99314152         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.91E-05 U           OESER_RI         SW-04         Yes         99314153         7/26/1999         Surface Water         RI         TEQDF 0.5M05         1.37E-05           OESER_RI         SW-05         Yes         99314155         7/27/1999         Surface Water         RI         TEQDF 0.5M05         3.49E-05 U

Source: Ecology and Environment. Inc., (E&E) March 2008.

## Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

# Key:

TCDD = tetrachlorodibenzo-p-dioxin

# Available TCDD screening values (see Table SV-1 notes on applicability):

MTCA Method B Surface Water Carcinogen	8.6E-09	ug/L
NAWQC, Water + Organism Consumption, 10-6 Cancer Risk	5.0E-09	ug/L
NAWQC, Water + Organism Consumption, 10-4 Cancer Risk	5.0E-07	ug/L
EPA Region 6 RBC - Residential	4.5E-07	ug/L

PA Value<sup>2</sup>

Table HH-1	Pentachlorophenol	Regulte for C	Croundwater at I	_ittle Squalicum Park¹.
Table nn-4.	rentacillolopileilo	results for c	nounuwatei at t	_IIIIE Suualiculli Faik.

Table HH-4. P	entachiorop	nenoi Resuits	for Groun	dwater at Li	ttle Squalicum	Рагк.									RA Value <sup>2</sup>
Site_Area	Event	Location	On_Site	Sample_ID	Sampling_Date	Upper_Depth	Lower_Depth	Depth_Unit	Matrix	Source	Analyte	VALUE_conv	Qualifier	Units_conv	(ug/L)
Lower creek	Integral RI	SB-18	Yes	LSP0367	2/20/2006	3.5	3.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Lower creek	Integral RI	SB-19	Yes	LSP0368	2/20/2006	2	2	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Lower creek	Integral RI	SB-20	Yes	LSP0369	2/20/2006	6.7	6.7	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	OESER_RI	WP1	Yes	99070515	8/11/1999	0	0		Groundwater	RI	Pentachlorophenol	2.7	U	ug/l	1.35
Upper creek	OESER_RI	WP2	Yes	99070516	8/11/1999	0	0		Groundwater	RI	Pentachlorophenol	0.84		ug/l	0.84
Upper creek	Integral RI	MWLSC03	Yes	99384363	9/16/1999				Groundwater	LSP RI	Pentachlorophenol	0.37		ug/l	0.37
Upper creek	OESER_RI	MWLSC02	Yes	99384350	9/16/1999	19.25	28.80	ft	Groundwater	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Upper creek	OESER_RI	MWLSC01	Yes	99384358	9/16/1999	21.25	30.80	ft	Groundwater	RI	Pentachlorophenol	0.024	U	ug/l	0.012
Upper creek	Integral RI	MWLSC03	Yes	99504022	12/8/1999				Groundwater	LSP RI	Pentachlorophenol	0.024	U	ug/l	0.012
Upper creek	OESER_RI	MWLSC01	Yes	99504038	12/9/1999	21.25	30.80	ft	Groundwater	RI	Pentachlorophenol	0.025		ug/l	0.025
Upper creek	OESER_RI	MWLSC02	Yes	99504040	12/10/1999	19.25	28.80	ft	Groundwater	RI	Pentachlorophenol	0.058		ug/l	0.058
Upper creek	Integral RI	MWLSC03	Yes	94075	3/1/2000				Groundwater	LSP RI	Pentachlorophenol	0.054		ug/l	0.054
Upper creek	OESER RI	MWLSC02	Yes	94080	3/1/2000	19.25	28.80	ft	Groundwater	RI	Pentachlorophenol	0.17		ug/l	0.17
Upper creek	OESER_RI	MWLSC01	Yes	94081	3/1/2000	21.25	30.80	ft	Groundwater	RI	Pentachlorophenol	0.025		ug/l	0.025
Upper creek	Integral RI	MWLSC02	Yes	LSP0010	11/3/2005	19.99	19.99	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	MWLSC03	Yes	LSP0013	11/3/2005	27.33	27.33	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-13	Yes	LSP0370	2/20/2006	9	9	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-09	Yes	LSP0372	2/21/2006	9.5	9.5	ft	Groundwater	LSP RI	Pentachlorophenol	90		ug/l	90
Upper creek	Integral RI	SB-14	Yes	LSP0374	2/21/2006	9.5	9.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-22	Yes	LSP0373	2/21/2006	27.40	29.20	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-21	Yes	LSP0371	2/21/2006	28.73	31.40	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-11	Yes	LSP0375	2/22/2006	9	9	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	MWLSC03	Yes	LSP0379	2/22/2006	25.00	28.00	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-23	Yes	LSP0378	2/22/2006	27.50	30.05	ft	Groundwater	LSP RI	Pentachlorophenol	5.1		ug/l	5.1
Upper creek	Integral RI	SB-24	Yes	LSP0377	2/22/2006	27.75	30.75	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	MWLSC02	Yes	LSP0381	2/23/2006	21.00	21.00	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-26	Yes	LSP0593	5/1/2006	3.5	3.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-27	Yes	LSP0594	5/1/2006	4	4	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-32	Yes	LSP0598	5/1/2006	2.5	2.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-25	Yes	LSP0591	5/2/2006	3	3	ft	Groundwater	LSP RI	Pentachlorophenol	460		ug/l	460
Upper creek	Integral RI	SB-28	Yes	LSP0595	5/2/2006	7.5	7.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
Upper creek	Integral RI	SB-29	Yes	LSP0596	5/2/2006	8	8	ft	Groundwater	LSP RI	Pentachlorophenol	16		ug/l	16
Upper creek	Integral RI	SB-30	Yes	LSP0597	5/2/2006	5.5	5.5	ft	Groundwater	LSP RI	Pentachlorophenol	0.91	UJ	ug/l	0.455
	-	•	•	•	•	•				•				-	

## Notes:

## Key:

bgs = below ground surface

Available PCP screening values (see Table SV-1 notes on applicability):

MTCA Method B Groundwater Carcinogen 0.73 ug/L EPA Maximum Contaminant Level (MCL) 1 ug/L

<sup>1.</sup> Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

<sup>2.</sup> RA Value = Risk assessment value; undetected results are included in this column at 0.5 times the reported quantitation limit.

Table HH-5. Carcinogenic PAH Results (as Benzo(a)pyrene Equivalent Concentration) for Groundwater at Little Squalicum Park¹.

Site_Area	Event	Location	On_Site		Sampling_Date	·				Source	Analyte	VALUE_conv	Qualifier	Units_conv
Lower creek	Integral RI	SB-18	Yes	LSP0367	2/20/2006	3.5	3.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Lower creek	Integral RI	SB-19	Yes	LSP0368	2/20/2006	2	2	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.2785	J	ug/l
Lower creek	Integral RI	SB-20	Yes	LSP0369	2/20/2006	6.7	6.7	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	OESER_RI	WP1	Yes	99070515	8/11/1999	0	0		Groundwater	RI	TEQBAP (ND = 1/2 DL)	215.9	J	ug/l
Upper creek	OESER_RI	WP2	Yes	99070516	8/11/1999	0	0		Groundwater	RI	TEQBAP (ND = 1/2 DL)	1.505	J	ug/l
Upper creek	OESER_RI	MWLSC02	Yes	99384350	9/16/1999	19.25	28.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.0048	U	ug/l
Upper creek	OESER_RI	MWLSC01	Yes	99384358	9/16/1999	21.25	30.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.0048	U	ug/l
Upper creek	OESER_RI	MWLSC01	Yes	99504038	12/9/1999	21.25	30.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.0049	U	ug/l
Upper creek	OESER_RI	MWLSC02	Yes	99504040	12/10/1999	19.25	28.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.0047	U	ug/l
Upper creek	OESER_RI	MWLSC02	Yes	94080	3/1/2000	19.25	28.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.004108		ug/l
Upper creek	OESER_RI	MWLSC01	Yes	94081	3/1/2000	21.25	30.80	ft	Groundwater	RI	TEQBAP (ND = 1/2 DL)	0.0048	U	ug/l
Upper creek	Integral RI	MWLSC02	Yes	LSP0010	11/3/2005	19.99	19.99	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	MWLSC03	Yes	LSP0013	11/3/2005	27.33	27.33	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.48	UJ	ug/l
Upper creek	Integral RI	SB-13	Yes	LSP0370	2/20/2006	9	9	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-09	Yes	LSP0372	2/21/2006	9.5	9.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	2.647	J	ug/l
Upper creek	Integral RI	SB-14	Yes	LSP0374	2/21/2006	9.5	9.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	4.391	J	ug/l
Upper creek	Integral RI	SB-22	Yes	LSP0373	2/21/2006	27.40	29.20	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	4.422	J	ug/l
Upper creek	Integral RI	SB-21	Yes	LSP0371	2/21/2006	28.73	31.40	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-11	Yes	LSP0375	2/22/2006	9	9	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	MWLSC03	Yes	LSP0379	2/22/2006	25.00	28.00	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-23	Yes	LSP0378	2/22/2006	27.50	30.05	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-24	Yes	LSP0377	2/22/2006	27.75	30.75	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	MWLSC02	Yes	LSP0381	2/23/2006	21.00	21.00	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-26	Yes	LSP0593	5/1/2006	3.5	3.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-27	Yes	LSP0594	5/1/2006	4	4	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-32	Yes	LSP0598	5/1/2006	2.5	2.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-25	Yes	LSP0591	5/2/2006	3	3	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.2645	J	ug/l
Upper creek	Integral RI	SB-28	Yes	LSP0595	5/2/2006	7.5	7.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l
Upper creek	Integral RI	SB-29	Yes	LSP0596	5/2/2006	8	8	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	3.674	J	ug/l
Upper creek	Integral RI	SB-30	Yes	LSP0597	5/2/2006	5.5	5.5	ft	Groundwater	LSP RI	TEQBAP (ND = 1/2 DL)	0.72	UJ	ug/l

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

# Key:

bgs = below ground surface

PAH = polycyclic aromatic hydrocarbon

Available carcinogenic PAH screening values (see Table SV-1 notes on applicability):

MTCA Method B Groundwater Carcinogen 0.012 ug/L EPA Maximum Contaminant Level (MCL) 0.2 ug/L

Table HH-6. Dioxin/Furan Results (as 2,3,7,8-TCDD Toxic Equivalent Concentration) for Groundwater at Little Squalicum Park¹.

Site_Area	Event	Location	On_Site	Sample_ID	Sampling_Date	Upper_Depth	Lower_Depth	Depth_Unit	Matrix	Source	Analyte	VALUE_conv	Qualifier	Units_conv
Upper creek	OESER_RI	MWLSC02	Yes	99384350	9/16/1999	19.25	28.800	ft	Groundwater	RI	TEQDF 0.5M05	2.63E-05	U	ug/l
Upper creek	OESER_RI	MWLSC01	Yes	99384358	9/16/1999	21.25	30.800	ft	Groundwater	RI	TEQDF 0.5M05	4.02E-06	U	ug/l
Upper creek	OESER_RI	MWLSC03	Yes	99384363	9/16/1999				Groundwater	RI	TEQDF 0.5M05	2.10E-05	U	ug/l
Upper creek	OESER_RI	MWLSC03	Yes	99504022	12/8/1999				Groundwater	RI	TEQDF 0.5M05	4.16E-05	U	ug/l
Upper creek	OESER_RI	MWLSC01	Yes	99504038	12/9/1999	21.25	30.800	ft	Groundwater	RI	TEQDF 0.5M05	1.30E-05	U	ug/l
Upper creek	OESER_RI	MWLSC02	Yes	99504040	12/10/1999	19.25	28.800	ft	Groundwater	RI	TEQDF 0.5M05	1.2276E-05		ug/l
Upper creek	OESER_RI	MWLSC03	Yes	94075	3/1/2000				Groundwater	RI	TEQDF 0.5M05	6.45523E-06		ug/l
Upper creek	OESER_RI	MWLSC02	Yes	94080	3/1/2000	19.25	28.800	ft	Groundwater	RI	TEQDF 0.5M05	6.58754E-06		ug/l
Upper creek	OESER_RI	MWLSC01	Yes	94081	3/1/2000	21.25	30.800	ft	Groundwater	RI	TEQDF 0.5M05	2.71074E-06		ug/l
Upper creek	Integral RI	MWLSC02	Yes	LSP0010	03-Nov-05	19.990	19.990	ft	Groundwater	LSP RI	TEQDF 0.5M05	1.25E-05	J	ug/l
Upper creek	Integral RI	MWLSC03	Yes	LSP0013	03-Nov-05	27.330	27.330	ft	Groundwater	LSP RI	TEQDF 0.5M05	1.33E-05	J	ug/l
Upper creek	Integral RI	SB-14	Yes	LSP0374	2/21/2006	9.5	9.5	ft	Groundwater	LSP RI	TEQDF 0.5M05	2.77E-05	J	ug/l
Upper creek	Integral RI	SB-21	Yes	LSP0371	21-Feb-06	28.730	31.400	ft	Groundwater	LSP RI	TEQDF 0.5M05	9.33E-06	J	ug/l
Upper creek	Integral RI	SB-22	Yes	LSP0373	21-Feb-06	27.400	29.200	ft	Groundwater	LSP RI	TEQDF 0.5M05	1.85E-04	J	ug/l
Upper creek	Integral RI	SB-11	Yes	LSP0375	2/22/2006	9	9	ft	Groundwater	LSP RI	TEQDF 0.5M05	6.81E-06	J	ug/l
Upper creek	Integral RI	SB-24	Yes	LSP0377	22-Feb-06	27.75	30.75	ft	Groundwater	LSP RI	TEQDF 0.5M05	5.33E-05	J	ug/l
Upper creek	Integral RI	MWLSC03	Yes	LSP0379	22-Feb-06	25	28	ft	Groundwater	LSP RI	TEQDF 0.5M05	1.13E-05	J	ug/l
Upper creek	Integral RI	MWLSC02	Yes	LSP0381	23-Feb-06	21	21	ft	Groundwater	LSP RI	TEQDF 0.5M05	4.54E-06	J	ug/l
Upper creek	Integral RI	SB-32	Yes	LSP0598	5/1/2006	2.5	2.5	ft	Groundwater	LSP RI	TEQDF 0.5M05	6.64E-06	J	ug/l
Upper creek	Integral RI	SB-25	Yes	LSP0591	5/2/2006	3	3	ft	Groundwater	LSP RI	TEQDF 0.5M05	5.04E-06	J	ug/l
Upper creek	Integral RI	SB-29	Yes	LSP0596	5/2/2006	8	8	ft	Groundwater	LSP RI	TEQDF 0.5M05	8.91E-06	J	ug/l

Source: Ecology and Environment, Inc. (E&E), March 2008.

Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

Key:

bgs = below ground surface

TCDD = tetrachlorodibenzo-p-dioxin

Available TCDD screening values (see Table SV-1 notes on applicability):

MTCA Method B Groundwater Carcinogen 5.8E-07 ug/L EPA Maximum Contaminant Level (MCL) 3.0E-05 ug/L

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Site Area	Event	Location	On Site	Sample ID	Sampling Date			Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units	(mg/kg)
Beach	OESER_RI	OS01	Yes	95352500	1/1/1996	0.0	+	t .	Surface Sediment	ESI	Pentachlorophenol	0.0391	J	mg/kg	0.039
General Site	OESER_RI	RES-47A	Yes	99224036	5/26/1999	0.0	0.2 f	t .	Surface Soil	RI	Pentachlorophenol	0.713	U	mg/kg	0.356
General Site	OESER_RI	RES-48	Yes	99224034	5/26/1999	0.0		t	Surface Soil	RI	Pentachlorophenol	0.781	U	mg/kg	0.390
General Site	OESER_RI	RES-49	Yes	99224035	5/26/1999	0.0	0.2 f	<u>t</u>	Surface Soil	RI	Pentachlorophenol	0.678		mg/kg	0.33
General Site	OESER_RI	SP07	Yes	99070656	8/6/1999	0.0		t	Surface Soil	RI	Pentachlorophenol	2.2	-	mg/kg	2.
Historical creek	Integral RI	TP-06	Yes	LSP0047	11/8/2005	3.0	4.0 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	0.045	UJ	mg/kg	0.022
Historical creek	Integral RI	TP-06	Yes	LSP0048	11/8/2005	4.0		it	Subsurface Soil	LSP RI	Pentachlorophenol	0.046	UJ	mg/kg	0.02
Historical creek	Integral RI	TP-06	Yes	LSP0046	11/8/2005	2.0	3.0 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	0.18		mg/kg	0.1
Historical creek	Integral RI	TP-06	Yes	LSP0044	11/8/2005	0.0	1.0 f	t	Surface Soil	LSP RI	Pentachlorophenol	1.1		mg/kg	1.
Historical creek	Integral RI	TP-06	Yes	LSP0045	11/8/2005	1.0	2.0 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	3.5		mg/kg	3.
Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0 f	it	Surface Soil	LSP RI	Pentachlorophenol	7.1		mg/kg	7.
Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0 f	it	Subsurface Soil	LSP RI	Pentachlorophenol	0.54	J	mg/kg	0.5
Historical creek	Integral RI	TP-21	Yes	LSP0102	11/17/2005	0.0	2.0 f	t	Surface Soil	LSP RI	Pentachlorophenol	0.14	UJ	mg/kg	0.0
Historical creek	Integral RI	SB-29	Yes	LSP0464	4/6/2006	5.0	5.5 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	0.38		mg/kg	0.3
Historical creek	Integral RI	SB-35	Yes	LSP0545	4/10/2006	0.0	1.0 f	't	Surface Sediment	LSP RI	Pentachlorophenol	0.28	UJ	mg/kg	0.1
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1.0	1.8 f	't	Subsurface Sediment	LSP RI	Pentachlorophenol	7.3		mg/kg	7.
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0.0	0.8 f	t	Surface Sediment	LSP RI	Pentachlorophenol	7.9		mg/kg	7.
Historical creek	Integral RI	SB-37	Yes	LSP0553	4/10/2006	1.2	2.0 f	t	Subsurface Sediment	LSP RI	Pentachlorophenol	0.15	J	mg/kg	0.1
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0.0	1.2 f	it	Surface Sediment	LSP RI	Pentachlorophenol	1.3		mg/kg	1.
Historical creek	Integral RI	SB-34	Yes	LSP0555	4/11/2006	0.0	1.1 f	it	Surface Sediment	LSP RI	Pentachlorophenol	0.28	UJ	mg/kg	0.1
Historical creek	Integral RI	SB-38	Yes	LSP0558	4/11/2006	1.0	1.9 f	t	Subsurface Sediment	LSP RI	Pentachlorophenol	0.14	UJ	mg/kg	0.0
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0.0	1.0 f	t	Surface Sediment	LSP RI	Pentachlorophenol	3.6		mg/kg	3.
Historical creek	Integral RI	SB-39	Yes	LSP0563	4/11/2006	0.0	0.7 f	t	Surface Sediment	LSP RI	Pentachlorophenol	2.7		mg/kg	2.
Illinois Street	Integral RI	SB-42	No	LSP0685	1/29/2007	36.5	38.0 f	't	Subsurface Soil	LSP RI	Pentachlorophenol	0.13	J	mg/kg	0.1
Illinois Street	Integral RI	SB-42	No	LSP0685	1/29/2007	36.5	38.0 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	0.012	U	mg/kg	0.0
Landfill	Integral RI	TP-23	Yes	LSP0110	1/31/2006	3.5	4.0 f	t	Subsurface Soil	LSP RI	Pentachlorophenol	0.046	UJ	mg/kg	0.02
Landfill	Integral RI	TP-23	Yes	LSP0108	1/31/2006	0.0	2.0 f	it	Surface Soil	LSP RI	Pentachlorophenol	0.35	J	mg/kg	0.3
Lower creek	OESER_RI	OS02	Yes	95352501	1/1/1996	0.0	0.5 f	't	Surface Sediment	ESI	Pentachlorophenol	0.869	J	mg/kg	0.86
Lower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0.0	0.5 f	't	Surface Sediment	RI	Pentachlorophenol	0.0037	J	mg/kg	0.003
Lower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0.0	0.5 f	't	Surface Sediment	RI	Pentachlorophenol	0.033		mg/kg	0.03
Lower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0.0	0.5 f	't	Surface Sediment	RI	Pentachlorophenol	2	J	mg/kg	
Lower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0.0	0.5 f	it .	Surface Sediment	RI	Pentachlorophenol	0.024		mg/kg	0.02
Lower creek	Ecology2003	LSC-01	Yes	3394040	9/25/2003	0.0			Surface Sediment	Ecology2003	Pentachlorophenol	0.617		mg/kg	0.61
Lower creek	Ecology2003	LSC-02	Yes	3394041	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	Pentachlorophenol	1.26	J	mg/kg	1.2
Lower creek	Ecology2003	LSC-03	Yes	3394042	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	Pentachlorophenol	4.33		mg/kg	4.3
Lower creek	Ecology2003	LSC-S1	Yes	3394047	9/25/2003	0.0	0.0		Surface Soil	Ecology2003	Pentachlorophenol	5.96		mg/kg	5.9
Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1.0	2.0 f	t .	Subsurface Sediment	LSP RI	Pentachlorophenol	3.2		mg/kg	3.
Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0.0	1.0 f	it	Surface Sediment	LSP RI	Pentachlorophenol	4.5		mg/kg	4.
Lower creek	Integral RI	SB-10	Yes	LSP0181	2/6/2006	2.0	3.0 f	· ·	Subsurface Sediment	LSP RI	Pentachlorophenol	0.054		mg/kg	0.05
Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0 f	4	Surface Soil	LSP RI	Pentachlorophenol	0.034	ı	mg/kg	0.03
Lower creek	Integral RI	SB-19	Yes	LSP0263	2/10/2006	0.0	1.0 f	4	Surface Sediment	LSP RI	Pentachlorophenol	0.58		mg/kg	0.5
Lower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1.0		it .	Subsurface Sediment	LSP RI	Pentachlorophenol	0.71		mg/kg	0.7
	Integral RI	SB-19	Yes	LSP0253	2/10/2006	2.0	+	4	Subsurface Sediment	LSP RI	Pentachlorophenol	0.71			0.7
Lower creek		SB-19 SB-19						4				1		mg/kg	
Lower creek	Integral RI		Yes	LSP0254	2/10/2006	3.0	+	L L	Subsurface Sediment	LSP RI	Pentachlorophenol	1.6		mg/kg	1.
Lower creek	Integral RI	SB-20	Yes	LSP0271	2/10/2006	0.0	1.0 f		Surface Soil	LSP RI	Pentachlorophenol	0.4	1	mg/kg	0.
South Slope	OESER_RI	RES-43	Yes	99224021	5/25/1999	0.0		τ	Surface Soil	RI	Pentachlorophenol	0.661	U	mg/kg	0.330
South Slope	OESER_RI	RES-46 B-AA2	Yes Yes	99224022 99070532	5/25/1999 8/3/1999	0.0	0.2 f	t	Surface Soil Surface Soil	RI RI	Pentachlorophenol Pentachlorophenol	0.953	U	mg/kg	0.476

South Slope	OESER_RI	B-AA4	Yes	99070533	8/3/1999	0.0	0.2	ft	Surface Soil	RI	Pentachlorophenol	0.0085 J	mg/kg	0.0085
South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2	ft	Surface Soil	RI	Pentachlorophenol	0.011 J	mg/kg	0.011
South Slope	OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2	ft	Surface Soil	RI	Pentachlorophenol	0.012 U	mg/kg	0.006
South Slope	OESER_RI	B-BB5	Yes	99070536	8/3/1999	0.0	0.2	ft	Surface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
South Slope	OESER_RI	B-AA2	Yes	99070587	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
South Slope	OESER_RI	B-AA4	Yes	99070589	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 U	mg/kg	0.006
South Slope	OESER_RI	B-AA6	Yes	99070591	8/5/1999	6.0	8.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 U	mg/kg	0.006
South Slope	OESER_RI	B-AA4	Yes	99070590	8/5/1999	18	20	ft	Subsurface Soil	RI	Pentachlorophenol	0.01 U	mg/kg	0.005
South Slope	OESER_RI	B-AA6	Yes	99070592	8/5/1999	18	20	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
South Slope	OESER_RI	B-AA4	Yes	99070588	8/5/1999	36	38	ft	Subsurface Soil	RI	Pentachlorophenol			
South Slope	OESER_RI	B-BB3	Yes	99070596	8/6/1999	2.0	4.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.013 U	mg/kg	0.0065
South Slope	OESER RI	B-BB5	Yes	99070593	8/6/1999	4.0	6.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
South Slope	OESER_RI	B-BB5	Yes	99070595	8/6/1999	18	20	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
South Slope	OESER_RI	B-BB5	Yes	99070597	8/6/1999	18	20	ft	Subsurface Soil	RI	Pentachlorophenol	0.012 UJ	mg/kg	0.06
Upper creek	OESER_RI	OS03	Yes	95352502	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	Pentachlorophenol	1.75	mg/kg	1.75
Upper creek	OESER_RI	OS04	Yes	95352503	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	Pentachlorophenol	0.875 J	mg/kg	0.875
Upper creek	OESER RI	OS05	Yes	95352504	1/1/1996	0.0			Surface Sediment	ESI	Pentachlorophenol	0.563 J	mg/kg	0.563
Upper creek	OESER_RI	OS06	Yes	95352505	1/1/1996	0.0			Surface Sediment	ESI	Pentachlorophenol	2.17	mg/kg	2.17
Upper creek	OESER RI	SD05	Yes	99070524	7/28/1999	0.0	0.5		Surface Sediment	RI	Pentachlorophenol	0.056	mg/kg	0.056
Upper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0.0			Surface Sediment	RI	Pentachlorophenol	1.28 J	mg/kg	1.28
Upper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0.0	0.5		Surface Sediment	RI	Pentachlorophenol	0.015	mg/kg	0.015
Upper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0.0			Surface Sediment	RI	Pentachlorophenol	0.16	mg/kg	0.16
Upper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	Pentachlorophenol	1.1	mg/kg	1.1
Upper creek	OESER RI	SD10	Yes	99070529	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	Pentachlorophenol	2.9	mg/kg	2.9
Upper creek	OESER RI	MWLSC04	Yes	99070539	8/2/1999	12.0	14.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.01 UJ	mg/kg	0.005
Upper creek	OESER_RI	MWLSC04	Yes	99070538	8/2/1999	4.0	6.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 UJ	mg/kg	0.0055
Upper creek	OESER_RI	MWLSC01	Yes	99070511	8/5/1999	0.0			Surface Soil	RI	Pentachlorophenol	0.026	mg/kg	0.026
Upper creek	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2		Surface Soil	RI	Pentachlorophenol	0.015	mg/kg	0.015
Upper creek	OESER RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5		Surface Soil	RI	Pentachlorophenol	0.0056 J	mg/kg	0.0056
Upper creek	OESER RI	MWLSC04	Yes	99070514	8/5/1999	0.0			Surface Soil	RI	Pentachlorophenol	0.41	mg/kg	0.41
Upper creek	OESER_RI	TT01-B	Yes	99070647	8/5/1999	6.0	6.0		Subsurface Soil	RI	Pentachlorophenol	0.0093 J	mg/kg	0.0093
Upper creek	OESER_RI	TT01-BW	Yes	99070649	8/5/1999	2.5			Subsurface Soil	RI	Pentachlorophenol	0.0095 U	mg/kg	0.00475
Upper creek	OESER RI	TT01-SW	Yes	99070648	8/5/1999	4.0			Subsurface Soil	RI	Pentachlorophenol	0.01 U	mg/kg	0.005
Upper creek	OESER RI	MWLSC01	Yes	99070540	8/6/1999	10.0	12.0	ft	Subsurface Soil	RI	Pentachlorophenol	0.01 UJ	mg/kg	0.005
Upper creek	OESER RI	SP01	Yes	99070650	8/6/1999	0.0		ft	Surface Soil	RI	Pentachlorophenol	1.1	mg/kg	1.1
Upper creek	OESER RI	SP02	Yes	99070651	8/6/1999	0.0	0.5		Surface Soil	RI	Pentachlorophenol	0.15 UJ	mg/kg	0.075
Upper creek	OESER_RI	SP03	Yes	99070652	8/6/1999	0.0			Surface Soil	RI	Pentachlorophenol	1.8	mg/kg	1.8
Upper creek	OESER RI	SP04	Yes	99070653	8/6/1999	0.0			Surface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
Upper creek	OESER RI	SP05	Yes	99070654	8/6/1999	0.0	0.5		Surface Soil	RI	Pentachlorophenol	1.2	mg/kg	1.2
Upper creek	OESER_RI	SP06	Yes	99070655	8/6/1999	0.0			Surface Soil	RI	Pentachlorophenol	1.4 J	mg/kg	1.4
Upper creek	OESER_RI	MWLSC01	Yes	99070541	8/6/1999	18			Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.055
Upper creek	OESER_RI	MWLSC01	Yes	99070542	8/6/1999	34			Subsurface Soil	RI	Pentachlorophenol	0.13 J	mg/kg	0.13
Upper creek	OESER RI	MWLSC02	Yes	99070545	8/7/1999	10.0	12.0		Subsurface Soil	RI	Pentachlorophenol	0.011 U	mg/kg	0.0055
Upper creek	OESER RI	MWLSC02	Yes	99070546	8/7/1999	22			Subsurface Soil	RI	Pentachlorophenol	0.1 UJ	mg/kg	0.0033
Upper creek	OESER_RI	MWLSC03	Yes	99070543	8/7/1999	28			Subsurface Soil	RI	Pentachlorophenol	0.098 J	mg/kg	0.098
Upper creek	OESER_RI	MWLSC03	Yes	99070547	8/7/1999	30			Subsurface Soil	RI	Pentachlorophenol	0.0983 0.012 U	mg/kg	0.098
Opper creek	OLOLIV_IVI	11111120002	100	00010041	0/1/1999	30	] 32		Cassariace Con	III	i entaciliolopileiloi	0.012	my/ky	0.00

Upper creek	OESER_RI	MWLSC03	Yes	99070544	8/7/1999	32	34	ft	Subsurface Soil	RI	Pentachlorophenol	0.011 UJ	mg/kg	0.055
Upper creek	Ecology2003	LSC-04	Yes	3394043	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	Pentachlorophenol	2.19 J	mg/kg	2.19
Upper creek	Ecology2003	LSC-06	Yes	3394045	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	Pentachlorophenol	4.27 J	mg/kg	4.27
Upper creek	Ecology2003	LSC-S2	Yes	3394048	9/25/2003	0.0	0.0		Surface Soil	Ecology2003	Pentachlorophenol	0.673 J	mg/kg	0.673
Upper creek	Integral RI	LSC Bank	Yes	LSP0051	11/7/2005	0.0	0.5	ft	Surface Sediment	LSP RI	Pentachlorophenol	1.8 J	mg/kg	1.8
Upper creek	Integral RI	SB-09	Yes	LSP0176	2/6/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.46	mg/kg	0.46
Upper creek	Integral RI	SB-09	Yes	LSP0179	2/6/2006	9.0	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	2	mg/kg	2
Upper creek	Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	4.4	mg/kg	4.4
Upper creek	Integral RI	SB-09	Yes	LSP0178	2/6/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	6.4	mg/kg	6.4
Upper creek	Integral RI	SB-11	Yes	LSP0191	2/7/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.046 UJ	mg/kg	0.023
Upper creek	Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1.2	mg/kg	1.2
Upper creek	Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0	ft	Surface Soil	LSP RI	Pentachlorophenol	0.375	mg/kg	0.375
Upper creek	Integral RI	SB-14	Yes	LSP0220	2/8/2006	5.0	6.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.047 UJ	mg/kg	0.0235
Upper creek	Integral RI	SB-14	Yes	LSP0219	2/8/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.1 UJ	mg/kg	0.05
Upper creek	Integral RI	SB-14	Yes	LSP0222	2/8/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-14	Yes	LSP0223	2/8/2006	9.0	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-14	Yes	LSP0221	2/8/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.16	mg/kg	0.16
Upper creek	Integral RI	SB-14	Yes	LSP0226	2/9/2006	10.0	11.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-11	Yes	LSP0274	2/11/2006	0.0	1.0	ft	Surface Soil	LSP RI	Pentachlorophenol	0.24 J	mg/kg	0.24
Upper creek	Integral RI	SB-11	Yes	LSP0275	2/11/2006	1.0	2.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1 UJ	mg/kg	0.5
Upper creek	Integral RI	SB-22	Yes	LSP0324	2/14/2006	25.5	27	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.064 J	mg/kg	0.064
Upper creek	Integral RI	SB-22	Yes	LSP0325	2/14/2006	27	28.5	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14 UJ	mg/kg	0.07
Upper creek	Integral RI	SB-22	Yes	LSP0326	2/14/2006	28.5	29.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.012 U	mg/kg	0.06
Upper creek	Integral RI	SB-22	Yes	LSP0327	2/14/2006	29.6	30	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.14	mg/kg	0.14
Upper creek	Integral RI	SB-22	Yes	LSP0328	2/14/2006	30	31	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.013 U	mg/kg	0.065
Upper creek	Integral RI	SB-29	Yes	LSP0474	4/6/2006	10.0	10.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.32 J	mg/kg	0.32
Upper creek	Integral RI	SB-29	Yes	LSP0464	4/6/2006	5.0	5.5	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.38	mg/kg	0.38
Upper creek	Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1.1	mg/kg	1.1
Upper creek	Integral RI	SB-31	Yes	LSP0514	4/7/2006	10.2	11.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.1 UJ	mg/kg	0.05
Upper creek	Integral RI	SB-31	Yes	LSP0509	4/7/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	0.11	mg/kg	0.11
Upper creek	Integral RI	SB-31	Yes	LSP0512	4/7/2006	9.6	10.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	1	mg/kg	1
Upper creek	Integral RI	SB-31	Yes	LSP0511	4/7/2006	9.0	9.6	ft	Subsurface Soil	LSP RI	Pentachlorophenol	2.1	mg/kg	2.1
Upper creek	Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	Pentachlorophenol	6.3	mg/kg	6.3
Wetlands	OESER_RI	OS07	Yes	95352506	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	Pentachlorophenol	0.926 U	mg/kg	0.463
Wetlands	OESER_RI	SD11	Yes	99070530	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	Pentachlorophenol	0.05 UJK	mg/kg	0.025
Wetlands	Ecology2003	LSC-05	Yes	3394044	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	Pentachlorophenol	1.27 J	mg/kg	1.27
Source: Ecology a	nd Environment	Inc. (ERE) More	sh 2000								•			

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

2. RA Value = Undetected results are included in this column at 0.5 times the reported quantitation limit.

## Key:

bgs = below ground surface RA = risk assessment

# Available PCP screening values (see Table SV-1 notes on applicability):

EPA Region 6 RBC - Residential3mg/kgMTCA Method B Direct Contact8.3mg/kgRecreational Use Screening Value (10-6 cancer risk)225mg/kgRecreational Use Screening Value (10-4 cancer risk)22,474mg/kg

Ecology and Environment, Inc.

3/6/2008

Table HH-8, Carcinogenic PAH Results (as Benzolalpyrene Equivalent Concentration) for Soil and Sediment at Little Squalicum Park 1

Standard Control   Standard Co	Table HH-8. (	Carcinogenic	PAH Result	s (as Ber	nzo[a]pyrene	Equivalent (	Concentration	on) for Soil a	and Sedir	ment at Little Squal	cum Park 1				
Second   S												Analyte	Result	Qualifier	Units
Concest Ref.   Confest Ref.   Conf	Beach	OESER RI	OS01	Yes					ft		ESI	TEQBAP (ND = 1/2 DL)	0.095536	J	ma/ka
Concess   March   March   Concess   March   Concess   March   Concess   March   March   Concess   March   March   Concess   March   March   Concess   March   Ma	General Site	OESER RI		Yes		5/26/1999	0.0	0.2	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)		J	
Content State   Content Stat									ft			,		11	
Content   Cont									ft					ı	
Parenter   Company   Parenter									n.						
Marcourd costs						0.0			n n					J	
Proposed creek   Proposed RT   Pri-OR   Visc   1970-005   118/0000   20   3.0 h   Sectorize Sed   3.9 h   TGGARP (FIG. 10 D.)   22.3 h   Pri-OR   Visc   1970-005   118/0000   20   3.0 h   Sectorize Sed   3.9 h   TGGARP (FIG. 10 D.)   10.2 h   Sectorize Sed   3.9 h   TGGARP (FIG. 10 D									π						
Financial Code   Impage   RT   Pri-06   Very   Springer   11800000   10   2.0 h   Springer   Spri									ft				0.000		
Manufact costs									ft						
Intention cross   Impage   RT	Historical creek	Integral RI	TP-06	Yes	LSP0046	11/8/2005	2.0		ft	Subsurface Soil		TEQBAP (ND = 1/2 DL)	46.92		mg/kg
International Prograph RF   TPC7   Veal   6,69000   1119,0005   1.0   2.0   1.0   50   50   50   50   50   50   50	Historical creek	Integral RI	TP-06	Yes	LSP0045	11/8/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	102.79		mg/kg
Proceed news    Process	Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0	ft	Surface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	93.94		mg/kg
Improved creek   Improved RV	Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	66.16		mg/kg
Imported cross  Negogia RT   60-26   Ves   1579-056   4192000   10   R.   B. Southers Seelment   15 P. R.   TGGAR PD = 12 CQ   22810   npgls   15 P. R.	Historical creek	Integral RI	TP-21	Yes	LSP0102	11/17/2005	0.0	2.0	ft	Surface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	3.873		
Production contents   1899   18   18   18   18   18   18	Historical creek		SB-35	Yes	LSP0545	4/10/2006	0.0	1.0	ft	Surface Sediment	I SP RI	TEOBAP (ND = 1/2 DL)	0.2815		
International contents   International Conte									ft						
International contents   Integral RS   80-37   Vest   1,599553									ft						
Electrical cross   Integral R   80-37   Ven   SP0902									4						
Intended cross    Integral R    S-34   Ves   L5P0555									n n						
Exercised certification of the Historian Create									π.						
Intercret combox   Integral Ris   Se 3-83   Ves   LSPR061									ft						
Internal creams   Integrant R   SR-30   Vers   SSP5963   4411,0006   0.0   0.7   1   Surface Selement   SSP R   TGGARP (ND = 17 0L)   10272   mg/sq   Lardill   Integrant R   17-23   Vers   SSP110   1511,0006   0.3   0.1   Substrates Soil   SSP R   TGGARP (ND = 12 0L)   0.04561   J. mg/sq   Lardill   Integrant R   TF-23   Vers   SSP5108   1510,0006   0.0   0.0   0.0   Substrates Soil   SSP R   TGGARP (ND = 12 0L)   0.04561   J. mg/sq   Lardill   Integrant R   TF-23   Vers   SSP5108   1510,0006   0.0   0.0   1   Substrates Soil   SSP R   TGGARP (ND = 12 0L)   0.04561   J. mg/sq   Lardill   Lardill   Vers   SSS5501   Vers   SSS5501   Vers									π				0.00		
Brook   Mangar R   Pr-23   Yes   S97010   1310200   3.5   3.8   Substrates Boll   SPR IN TGGARP (ND = 12 CL)   3.294   mg/kg   Landfill   Hongar R   Pr-23   Yes   S97010   1310200   3.5   4.0   5.									ft						
Landfill     Design R   Tr-22   Ves   LSP0110   1/31/2006   0.0   0.0   1   Implies   Lower creek   CSER R   TGSAP (NO = 1/2 DL)   0.04564   1   Implies   Lower creek   CSER R   TGSAP (NO = 1/2 DL)   0.04564   1   Implies   Lower creek   CSER R   TGSAP (NO = 1/2 DL)   2.1419   Implies   Lower creek	Historical creek	Integral RI	SB-39	Yes	LSP0563	4/11/2006			ft	Surface Sediment	LSP RI	TEQBAP (ND = 1/2 DL)			mg/kg
Londiff   Hongard R   TP-22   Yes   LSP01108   1510.0006   3.5   4.0   1   Suburifiee Soil   SPR R1   TEGBAP (ND = 12 Cb)   0.0486   1   mg/kg   Loner creek   0.655 R7   R   0.5022   Yes   950.0007   1711.0006   0.0   0.0   1   Surface Soil member   SSR R1   TEGBAP (ND = 12 Cb)   0.0681   mg/kg   Loner creek   0.655 R7   R   0.5022   Yes   950.0007   0.0   0.0   1   Surface Soilment   SSR R1   TEGBAP (ND = 12 Cb)   2.1419   mg/kg   1.0007   0.0   0.0   1   Surface Soilment   SSR R1   TEGBAP (ND = 12 Cb)   0.0007   0.0   0.0   1   Surface Soilment   SSR R1   TEGBAP (ND = 12 Cb)   0.0007   0.0   0.0   1   Surface Soilment   SSR R1   TEGBAP (ND = 12 Cb)   0.0007   0.0	Illinois Street	Integral RI	SB-42	No	LSP0685	29-Jan-07	36.5	38	ft	Subsurface Soil		TEQBAP (ND = 1/2 DL)	3.294		mg/kg
Lower creek   CESER RI   SOS   Yes   SSSSSSSS   11/1096   O. O   2.0 ft   Surface Soliton   ESI   TEGRAP (NO - 17.0 L)   0.0881   J mpkg   Cover creek   CESER RI   SOS1   Yes   SOS70503   77.991999   O. O   O. 5 ft   Surface Soliton   ESI   TEGRAP (NO - 17.0 L)   0.005705   J mpkg   Cover creek   CESER RI   SOS1   Yes   SOS70503   77.991999   O. O   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.005705   J mpkg   Cover creek   CESER RI   SOS3   Yes   SOS70503   77.991999   O. O   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.005705   J mpkg   Cover creek   SOSS   Yes   SOS70503   77.991999   O. O   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.01712   J mpkg   Cover creek   Sossion   Sosion   Yes   SOS70503   O. O   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.01712   J mpkg   Cover creek   Sosion   Sosion   Yes   SOS70503   O. O   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.05142   J mpkg   Cover creek   Sosion   Sosion   Yes   SOS4040   SOS50003   O. 0   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.05142   J mpkg   Cover creek   Sosion   Sosion   Sosion   Yes   SOS4040   SOS50003   O. 0   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.05142   J mpkg   Cover creek   Sosion   Sosion   Sosion   Yes   SOS4040   SOS50003   O. 0   O. 5 ft   Surface Soliton   RI   TEGRAP (NO - 17.0 L)   0.05142   J mpkg   Cover creek   Sosion   S	Landfill	Integral RI		Yes	LSP0110	1/31/2006	3.5	4.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.04364	J	
Convert creek   COSER, PR   COSQ   Yes   09:535:501   1/1/1909   0.0   0.5   1   Surface Sediment   ESI   TEOSAR* (NO. 1-12 D.L.)   0.055708   1/1/1909   0.0   0.5   1   Surface Sediment   RI   TEOSAR** (NO. 1-12 D.L.)   0.055708   1/1/1909   1/1/1909   0.0   0.5   1   Surface Sediment   RI   TEOSAR** (NO. 1-12 D.L.)   0.055708   1/1/1909   1/1/1909   0.0   0.5   1   Surface Sediment   RI   TEOSAR** (NO. 1-12 D.L.)   0.1/172   1   mg/kg   1/1/1908   1/1/1908   1/1/1909   0.0   0.5   1   Surface Sediment   RI   TEOSAR** (NO. 1-12 D.L.)   0.1/172   1   mg/kg   1/1/1908   1/1/1908   1/1/1909   0.0   0.5   1   Surface Sediment   RI   TEOSAR** (NO. 1-12 D.L.)   0.051425   J   mg/kg   1/1/1908   1/1									ft					J	
Lower creek   CESER, RI   SO01   Yes   907/0520   728/1999   0.0   0.5 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.00706   mg/kg   1.0 mer creek   CESER, RI   SO03   Yes   907/0522   7728/1999   0.0   0.5 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.01712   J. mg/kg   0.0   0.5 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.01712   J. mg/kg   0.0   0.5 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.01712   J. mg/kg   0.0   0.5 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051422   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051422   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.051423   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.05142   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.05142   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.05142   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.05142   J. mg/kg   0.0 th   Surface Sediment RI   TEGBAP (No. 1-12 DL)   0.05142   J. mg/kg   0.0 th   Surface Sediment RI   D. Mg/kg   0.0 th   D. Mg/									ft				2.1419		
Lever creek				Yes	99070520				ft	Surface Sediment				J	
Lower creek   CSER, RI   S003   Yes   8907/6522   7728/1989   O. O   O. D. B   Surface Sediment   RI   TEGBAP (No = 12 D.L)   0.05142   J. mg/kg									ft					1	
Lower creek   GESER, RI   SD04   Yes   96779523   7,281199   O.0   O.5   R   Surface Sediment   R1   TCGBAP (NO = 17.0 L)   0.05142E   J   mg/kg   Lower creek   Gology/2003   SC-02   Yes   3394041   9752003   O.0   O.0   Surface Sediment   Ecology/2003   TCGBAP (NO = 17.0 L)   3.0546   J   mg/kg   Lower creek   Gology/2003   SC-03   Yes   3394042   9752003   O.0   O.0   Surface Sediment   Ecology/2003   TCGBAP (NO = 17.0 L)   3.0546   J   mg/kg   Lower creek   Gology/2003   SC-03   Yes   3394047   9752003   O.0   O.0   Surface Sediment   Ecology/2003   TCGBAP (NO = 17.0 L)   3.0546   J   mg/kg   Lower creek   TGGBAP (NO = 17.0 L)   3.0546   J									4					1	
Lower creek   Ecolog/2003   S.C-0.1   Yes   398-044   9/25/2003   0.0   0.0   Surface Sediment   Ecolog/2003   TEGBAP NO = 1/2 DL   0.7391   mg/sq									n.		NI DI				
Lower creek   Ecology/2003   S.C-02   Yes   394041   9/25/2003   0 0 0 0 0   Surface Sediment   Ecology/2003   ECOAP P.No. 1/2 D.1   30,046   J mg/sg   Lower creek   Ecology/2003   S.C-51   Yes   394047   9/25/2003   0 0 0 0 0   Surface Soli   Ecology/2003   ECOAP P.No. 1/2 D.1   37/75   J mg/sg   Lower creek   Ecology/2003   S.C-51   Yes   394047   9/25/2003   0 0 0 0 0   Surface Soli   Ecology/2003   ECOAP P.No. 1/2 D.1   37/75   J mg/sg   Lower creek   Ecology/2003   S.C-51   Yes   394047   9/25/2003   0 0 0 0   Surface Soli   Ecology/2003   ECOAP P.No. 1/2 D.1   37/75   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   37/75   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   J mg/sg   Lower creek   Ecology/2003   ECOAP P.No. 1/2 D.1   34/61   Lower creek   Ecology/2003   EcoAP P.No. 1/2									π		RI			J	
Lewer creek   Ecology/2003   ESC-91   Yes   3394042   9252003   0.0   0.0   Surface Sediment   Ecology/2003   TEORAP (No = 12 DL)   28.922   J mg/kg   Lewer creek   Ecology/2003   TEORAP (No = 12 DL)   3.7075   J mg/kg   Lewer creek   Integral RI   S8-02   Yes   LSP0127   22/2006   1.0   2.0   N Subsurface Sediment   LSP RI   TEORAP (No = 12 DL)   3.461   J mg/kg   Lewer creek   Integral RI   S8-02   Yes   LSP0127   22/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   3.461   J mg/kg   Lewer creek   Integral RI   S8-10   Yes   LSP0181   22/2006   2.0   3.0   N Subsurface Sediment   LSP RI   TEORAP (No = 12 DL)   0.161   J mg/kg   Lewer creek   Integral RI   S8-10   Yes   LSP0181   22/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   0.161   J mg/kg   Lewer creek   Integral RI   S8-18   Yes   LSP0183   22/10/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   0.6228   J mg/kg   Lewer creek   Integral RI   S8-19   Yes   LSP0233   22/10/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   0.5228   J mg/kg   Lewer creek   Integral RI   S8-19   Yes   LSP0235   22/10/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   1.3377   mg/kg   Lewer creek   Integral RI   S8-19   Yes   LSP0235   22/10/2006   0.0   1.0   N Surface Sediment   LSP RI   TEORAP (No = 12 DL)   1.3377   mg/kg   Lewer creek   Integral RI   S8-19   Yes   LSP0235   22/10/2006   0.0   1.0   N Subsurface Sediment   LSP RI   TEORAP (No = 12 DL)   3.78   J mg/kg   Lewer creek   Integral RI   S8-19   Yes   LSP0235   22/10/2006   0.0   1.0   N Subsurface Sediment   LSP RI   TEORAP (No = 12 DL)   3.78   J mg/kg   Lewer creek   Integral RI   S8-20   Yes   LSP0235   22/10/2006   0.0   0.0   1.0   N Subsurface Sediment   LSP RI   TEORAP (No = 12 DL)   0.0   0						07-07-000									
Lower creek   Ecology/2003   ISC-S1   Yes   3304047   9,0550003   0.0   0.0   0.0   Surface Soil   Ecology/2003   ISC-S1   New Job 20   Yes   ISP0127   2/2/2006   0.0   1.0   1.0   IS surface Sediment   SP RI   TEGBAR (No = 1/2 DL)   3.461 J mg/kg   1.0   1.0   IS surface Sediment   SP RI   TEGBAR (No = 1/2 DL)   3.512 J mg/kg   1.0   ISP0127   2/2/2006   0.0   1.0   IS surface Sediment   SP RI   TEGBAR (No = 1/2 DL)   3.512 J mg/kg   1.0   ISP0128   1.0   ISP0128   2/2/2006   0.0   1.0   IS surface Sediment   SP RI   TEGBAR (No = 1/2 DL)   0.181 J mg/kg   1.0   ISP0128   ISP0128   1.0   ISP0128   1.0   ISP0128   1.0   ISP0128   I														J	
Lower creek   Integral RI   S8-02   Ves   LSP0127   22/2006   1.0   2.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   3.341   mg/kg   Lower creek   Integral RI   S8-10   Ves   LSP0181   22/2006   2.0   3.0   1.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   3.512   mg/kg   Lower creek   Integral RI   S8-10   Ves   LSP0181   22/2006   2.0   3.0   1.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   0.0281   J. mg/kg   Lower creek   Integral RI   S8-18   Ves   LSP0283   27/10/2006   0.0   1.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   0.0282   J. mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0283   27/10/2006   0.0   1.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   0.0282   J. mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0283   27/10/2006   0.0   1.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   3.78   J. mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0284   27/10/2006   2.0   3.0   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   8.70   mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0254   27/10/2006   3.0   3.6   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   8.70   mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0254   27/10/2006   0.0   0.1   0.1   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   8.70   mg/kg   Lower creek   Integral RI   S8-19   Ves   LSP0254   27/10/2006   0.0   0.1   0.1   Subsurface Sediment   LSP RI   TEGBAP ND = 12 DL,   8.70   mg/kg   South Stope   0.0	Lower creek													J	mg/kg
Lower creek   Integral RI   SB-02   Yes   LSP0132   22/2006   0.0   1.0   Nufface Sediment   LSP RI   TEGBAP NID = 12 DL)   3.512   J mg/kg	Lower creek	Ecology2003	LSC-S1	Yes	3394047	9/25/2003	0.0	0.0		Surface Soil	Ecology2003	TEQBAP (ND = 1/2 DL)	3.7075	J	mg/kg
Lower creek   Integral RI   SB-10   Ves   LSPD265   27102006   0.0   1.0   1.0   1.0   LSP RI   TEGBAP (ND - 12 DL)   0.2828   Jmpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   0.0   1.0   1.0   I Surface Soil   LSP RI   TEGBAP (ND - 12 DL)   1.3377   mpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   0.0   1.0   I Surface Sediment   LSP RI   TEGBAP (ND - 12 DL)   1.3377   mpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   2.0   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   3.79   Jmpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   2.0   3.0   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   3.79   Jmpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   2.0   3.0   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   3.79   Jmpkg   Lower creek   Integral RI   SB-19   Ves   LSPD265   27102006   3.0   3.6   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   2.181   mpkg   Sb-19   Ves   LSPD265   27102006   3.0   3.6   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   2.181   mpkg   Sb-19   Ves   LSPD265   27102006   3.0   3.6   I Subsurface Sediment   LSP RI   TEGBAP (ND - 12 DL)   2.0   3.79   mpkg   Sb-19	Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1.0	2.0	ft	Subsurface Sediment	LSP RI	TEQBAP (ND = 1/2 DL)	3.461	J	mg/kg
Lower creek   Integral RI   SB-18   Yes   LSP0250   21/10/2006   0.0   1.0  r   Surface Soli   LSP RI   TEGBAP (ND = 1/2 DL)   0.5288 J. mg/kg	Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0.0	1.0	ft	Surface Sediment	LSP RI	TEQBAP (ND = 1/2 DL)	3.512	J	mg/kg
Lower creek   Integral RI   SB-19   Yes   LSP0263   2.710/2006   0.0   1.0   R   Surface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   3.777   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0264   2.710/2006   2.0   3.0   R   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   3.79   J mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0253   2.710/2006   2.0   3.0   R   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   3.79   J mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0254   2.710/2006   3.0   3.6   R   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   2.18   mg/kg   Lower creek   Integral RI   SB-20   Yes   LSP0271   2.7110/2006   0.0   1.0   R   Surface Soil   LSP RI   TEGBAP (ND = 1/2 DL)   0.379   mg/kg   South Slope   O.SER, RI   RES-43   Yes   9.9224021   5.7251999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.379   mg/kg   South Slope   O.SER, RI   RES-43   Yes   9.9224021   5.7251999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.381   U mg/kg   South Slope   O.SER, RI   RES-44   Yes   9.92070532   8/3/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J mg/kg   South Slope   O.SER, RI   RES-44   Yes   9.99070533   8/3/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J mg/kg   South Slope   O.SER, RI   RES-44   Yes   9.99070533   8/3/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.000855   mg/kg   South Slope   O.SER, RI   RES-44   Yes   9.99070533   8/3/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.000805   mg/kg   South Slope   O.SER, RI   RES-44   Yes   9.99070533   8/3/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.000805   mg/kg   South Slope   O.SER, RI   RES-45   RES-	Lower creek	Integral RI	SB-10	Yes	LSP0181	2/6/2006	2.0	3.0	ft	Subsurface Sediment	LSP RI	TEQBAP (ND = 1/2 DL)	0.181	J	mg/kg
Lower creek   Integral RI   SB-19   Yes   LSP0263   2.7102006   0.0   1.0   t   Surface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   1.3377   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0253   2.7102006   2.0   3.0   t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   3.70   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0253   2.7102006   2.0   3.0   t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   8.707   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0253   2.7102006   2.0   3.0   t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   8.707   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0254   2.7102006   0.0   1.0   t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   0.770   mg/kg   Lower creek   Integral RI   SB-20   Yes   LSP0271   2.7102006   0.0   1.0   t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   0.770   mg/kg   South Slope   OESER, RI   SB-20   Yes   SP224021   5.7261999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.770   mg/kg   South Slope   OESER, RI   SB-20   Yes   99224021   5.7261999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.19414   J   mg/kg   South Slope   OESER, RI   SB-240   Yes   99270532   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   B-AA4   Yes   99070533   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.000266   J   mg/kg   South Slope   OESER, RI   B-AA6   Yes   99070535   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.000266   J   mg/kg   South Slope   OESER, RI   B-BA3   Yes   99070535   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.000266   J   mg/kg   South Slope   OESER, RI   B-BA4   Yes   99070536   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.00026   J   mg/kg   South Slope   OESER, RI   B-AA6   Yes   99070537   8/3/1999   0.0   0.2   t   Surface Soll   RI   TEGBAP (ND = 1/2 DL)   0.00026   J   mg/kg   Sout	Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.6288	J	mg/kg
Lower creek   Integral RI   SB-19   Yes   LSP0264   270/2006   1.0   2.0  t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   3.76  J. mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0253   270/2006   2.0   3.0  t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   8.707   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0254   270/2006   3.0   3.8  t   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   2.181   mg/kg   Lower creek   Integral RI   SB-19   Yes   LSP0254   270/2006   0.0   1.0  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   2.181   mg/kg   South Stope   CSER, RI   RE-43   Yes   99224021   5/25/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.379   mg/kg   South Stope   CSER, RI   RE-44   Yes   99224021   5/25/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.381   U mg/kg   South Stope   CSER, RI   B-AA2   Yes   99070532   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J mg/kg   South Stope   CSER, RI   B-AA4   Yes   99070533   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070534   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0098185   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002616   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002610   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002610   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070557   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002211   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070569   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.00221   mg/kg   South Stope   CSER, RI   B-AA6   Yes   99070569   8/5/1999   6.0   8.0  t   Su	Lower creek	Integral RI	SB-19	Yes	LSP0263	2/10/2006	0.0	1.0	ft	Surface Sediment	I SP RI	TEOBAP (ND = 1/2 DL)	1.3377		
Lower creek   Integral RI   SB-19   Yes   LSP0253   2/10/2006   2.0   3.0   R   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   2.70   3.0   7.0   3									4						
Lower creek   Integral RI   SB-19   Yes   LSP0254   2710/2006   3.0   3.6   R   Subsurface Sediment   LSP RI   TEGBAP (ND = 1/2 DL)   21.81   mg/kg   Lower creek   Integral RI   SB-20   Yes   SE27027   2710/2006   0.0   1.0   R   Surface Soil   LSP RI   TEGBAP (ND = 1/2 DL)   0.879   mg/kg   South Slope   OESER, RI   RES-43   Yes   992/24021   5725/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.19414   J   mg/kg   South Slope   OESER, RI   RES-46   Yes   992/24022   5725/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070532   843/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070533   843/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070533   843/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.001865   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070534   873/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002560   mg/kg   South Slope   OESER, RI   SHBBS   Yes   99070536   873/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002561   mg/kg   South Slope   OESER, RI   SHBBS   Yes   99070536   873/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002715   mg/kg   South Slope   OESER, RI   SHBBS   Yes   99070536   873/1999   0.0   0.2   R   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002715   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070587   874/1999   6.0   8.0   R   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002715   mg/kg   South Slope   OESER, RI   SHA42   Yes   99070589   875/1999   6.0   8.0   R   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.00252   U mg/kg   South Slope   OESER, RI   SHA44   Yes   99070589   0.5 Aug-99   18   20   R   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.00252   U mg/kg   South Slope   OESER, RI   SHA44   Yes   99070									4					J	
Lower creek   Integral RI   SB-20   Yes   LSPQ271   2/10/2006   0.0   1.0   t   Surface Soil   LSP RI   TEGBAP (ND = 1/2 DL)   0.879   mg/kg   South Slope   OESER, RI   RES-43   Yes   992/24022   5/25/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.381   J   mg/kg   South Slope   OESER, RI   RES-46   Yes   992/24022   5/25/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.381   J   mg/kg   South Slope   OESER, RI   B-AA2   Yes   9907/0532   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   B-AA4   Yes   9907/0533   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0097   J   mg/kg   South Slope   OESER, RI   B-AA6   Yes   9907/0534   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002665   J   mg/kg   South Slope   OESER, RI   B-BA8   Yes   9907/0535   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.002666   J   mg/kg   South Slope   OESER, RI   B-BA8   Yes   9907/0536   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-BA8   Yes   9907/0536   8/3/1999   0.0   0.2   t   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA2   Yes   9907/0587   8/5/1999   6.0   8.0   t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER, RI   B-AA6   Yes   9907/0589   8/5/1999   6.0   8.0   t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER, RI   B-AA6   Yes   9907/0581   8/5/1999   6.0   8.0   t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA6   Yes   9907/0588   8/5/1999   6.0   8.0   t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA6   Yes   9907/0588   0.6   8.0   t   Subsurface Soil   RI   TEGBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-BA8									n.						
South Slope   OESER, RI   RES-46   Yes   992/24021   5/25/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0381 U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0532   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0381 U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0532   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0097 J   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0533   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.001885   mg/kg   South Slope   OESER, RI   B-AA6   Yes   992/0534   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.001885   mg/kg   South Slope   OESER, RI   B-BB3   Yes   992/0535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0026/065   J   mg/kg   South Slope   OESER, RI   B-BB5   Yes   992/0536   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-BB5   Yes   992/0536   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.00227   U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0589   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0589   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0589   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA4   Yes   992/0599   6.0   8.0  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA6   Yes   992/0599   0.5-Aug-99   18   20  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER, RI   B-AA5   Yes   992/0598   8/6/1999   2.0  t   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER, RI   B-BB5   Yes   992/0598   8/6/1999   2.0  t									π						
South Slope   QESER_RI   RES-46   Yes   99270522   5/25/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.381   U   mg/kg   South Slope   QESER_RI   B-AA2   Yes   99070532   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00197   J   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070533   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.001985   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070534   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0028065   J   mg/kg   South Slope   QESER_RI   B-BB3   Yes   99070535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00227   J   mg/kg   South Slope   QESER_RI   B-BB5   Yes   99070535   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00227   J   mg/kg   South Slope   QESER_RI   B-BB5   Yes   99070536   8/3/1999   0.0   0.2  t   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00227   J   mg/kg   South Slope   QESER_RI   B-AA2   Yes   99070587   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070591   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070591   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070591   8/5/1999   6.0   8.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   QESER_RI   B-AA6   Yes   99070599   8/5/1999   18   20  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   QESER_RI   B-AA8   Yes   99070599   8/6/1999   2.0   4.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   QESER_RI   B-AB3   Yes   99070599   8/6/1999   2.0   4.0  t   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   QESER_RI   B-BB3   Yes   99070599   8/6/1999									π.		LSP KI				
South Slope   OESER_RI   B-AA2   Yes   99070532   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00027 J   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070533   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0002665 J   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070534   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0002665 J   mg/kg   South Slope   OESER_RI   B-AB3   Yes   99070535   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.000265 J   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070535   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AB2   Yes   99070587   8/5/1999   0.0   0.2   ft   Surface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA2   Yes   99070587   8/5/1999   0.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070591   8/5/1999   0.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070591   8/5/1999   0.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070591   8/5/1999   0.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070598   8/5/1999   18   2.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070598   8/6/1999   3.6   3.8   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-BB3   Yes   99070598   8/6/1999   2.0   4.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070598   8/6/1999   4.0   6.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.00025 U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   990									ft		RI			J	
South Slope   OESER_RI   B-AA4   Ves   99070533   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025065   mg/kg   South Slope   OESER_RI   B-AA6   Ves   99070534   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025065   J   mg/kg   South Slope   OESER_RI   B-B83   Ves   99070536   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.00251   mg/kg   South Slope   OESER_RI   B-B85   Ves   99070536   8/3/1999   0.0   0.2   ft   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0027215   mg/kg   South Slope   OESER_RI   B-BA2   Ves   99070536   8/3/1999   6.0   8.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER_RI   B-AA4   Ves   99070587   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Ves   99070591   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Ves   99070591   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Ves   99070591   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Ves   99070590   O5-Aug-99   18   2.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA4   Ves   99070590   O5-Aug-99   18   2.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-BA4   Ves   99070593   0/5-Aug-99   36   38   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-BB5   Ves   99070593   0/5-Aug-99   36   38   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-BB5   Ves   99070593   0/5-Aug-99   18   2.0   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   Upper creek   OESER_RI   OS				Yes					ft					U	
South Slope   OESER_RI   B-AA6   Yes   99070534   8/3/1999   O.0   O.2   ft   Surface Soil   RI   TEGBAP (ND = 1/2 DL)   O.00256 J   mg/kg									ft		RI			J	
South Slope OESER_RI B-BB3 Yes 99070535 8/3/1999 0.0 0.2 ft Surface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070567 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0027215 mg/kg South Slope OESER_RI B-AA4 Yes 99070567 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA4 Yes 99070567 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA4 Yes 99070569 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070591 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070592 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA4 Yes 99070592 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA4 Yes 99070588 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070588 05-Aug-99 36 38 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070596 8/6/1999 4.0 6.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070596 8/6/1999 4.0 6.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0021 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0021 U mg/kg South Slope OESER_RI OSO3 Yes 95352503 1/1/1996 0.0 0.5 ft Sufface Sediment ESI TEQBAP (ND = 1/2 DL) 0	South Slope			Yes					ft	Surface Soil	RI				mg/kg
South Slope OESER_RI B-BB3 Yes 99070535 8/3/1999 0.0 0.2 ft Surface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070567 8/5/1999 0.0 0.2 ft Surface Soil RI TEQBAP (ND = 1/2 DL) 0.0027215 mg/kg South Slope OESER_RI B-AA2 Yes 99070567 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0023 U mg/kg South Slope OESER_RI B-AA4 Yes 99070568 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070569 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070591 8/5/1999 6.0 8.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070592 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070592 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-AA6 Yes 99070588 05-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070588 05-Aug-99 36 38 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070596 8/6/1999 4.0 6.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB3 Yes 99070596 8/6/1999 4.0 6.0 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0025 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0021 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0021 U mg/kg South Slope OESER_RI B-BB5 Yes 99070597 06-Aug-99 18 20 ft Subsurface Soil RI TEQBAP (ND = 1/2 DL) 0.0021 U mg/kg South Slope OESER_RI SD05 Yes 99352500 1/1/1996 0.0 0.5 ft Sufface Sediment ESI TEQBAP (ND = 1/2 DL) 1.04	South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0026065	J	mg/kg
South Slope   OESER_RI   B-BB5   Yes   99070536   8/3/1999   0.0   0.2 ft   Surface Soil   RI   TEOBAP (ND = 1/2 DL)   0.002715   mg/kg   South Slope   OESER_RI   B-AA2   Yes   99070587   8/5/1999   6.0   8.0 ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070589   8/5/1999   6.0   8.0 ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070589   8/5/1999   6.0   8.0 ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070592   OESER_AI   B-AA6   Yes   99070592   OESER_AI   B-AA6   Yes   99070592   OESER_AI   B-AA6   Yes   99070592   OESER_AI   B-AA4   Yes   99070590   OESER_AI   B-AA4   Yes   99070590   OESER_AI   B-AA4   Yes   99070590   OESER_AI   B-AA4   Yes   99070598   OESER_AI   OESER_AI   B-AA4   Yes   99070598   OESER_AI   OESER_		OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0025	U	
South Slope   OESER_RI   B-AA2   Yes   99070587   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070599   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070591   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-AA6   Yes   99070592   O5-Aug-99   18   20   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.001598   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070590   O5-Aug-99   18   20   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.001598   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070590   O5-Aug-99   36   38   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER_RI   B-AA4   Yes   99070596   S/6/1999   2.0   4.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-BB3   Yes   99070593   8/6/1999   2.0   4.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070593   8/6/1999   4.0   6.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070593   8/6/1999   4.0   6.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070597   O6-Aug-99   18   2.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg   South Slope   OESER_RI   B-BB5   Yes   99070597   O6-Aug-99   18   2.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0023   U   mg/kg   South Slope   OESER_RI   OS03   Yes   95352502   1/1/1996   0.0   0.5   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0023   U   mg/kg   Upper creek   OESER_RI   OS05   Yes   95352505   1/1/1996   0.0   0.5   ft   Surface Sediment   ESI   TEQBAP (ND = 1/2 DL)   14.324   mg/kg   Upper creek   OESER_RI									ft		RI				
South Slope   OESER_RI   B-AA4   Yes   99070589   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg						8/5/1999			ft		RI			U	
South Slope   OESER_RI   B-AA6   Yes   99070591   8/5/1999   6.0   8.0   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg									ft					U	
South Slope   OESER_RI   B-AA6   Yes   99070592   05-Aug-99   18   20   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.001598   mg/kg									ft					U	
South Slope   OESER_RI   B-AA4   Yes   99070590   05-Aug-99   18   20   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0022   U   mg/kg									ft					-	
South Slope   OESER_RI   B-AA4   Yes   99070588   05-Aug-99   36   38   ft   Subsurface Soil   RI   TEQBAP (ND = 1/2 DL)   0.0025   U   mg/kg									4		DI	` '			
South Slope									n.		DI.				
South Slope									π				0.000	U	
South Slope   OESER_RI   B-BB5   Yes   99070595   06-Aug-99   18   20   ft   Subsurface Soil   RI   TEOBAP (ND = 1/2 DL)   0.0021   U   mg/kg						0.0			tt					U	
South Slope									ft					U	
Upper creek         OESER_RI         OS03         Yes         95352502         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         5.5206         mg/kg           Upper creek         OESER_RI         OS04         Yes         95352503         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         9.448         mg/kg           Upper creek         OESER_RI         OS06         Yes         95352504         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         1.4.324         mg/kg           Upper creek         OESER_RI         OS06         Yes         95352505         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         1.4.324         mg/kg           Upper creek         OESER_RI         SD05         Yes         99070524         7/28/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.4047 J         mg/kg           Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI									ft					U	
Upper creek         OESER_RI         OS04         Yes         95352503         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         9.448         mg/kg           Upper creek         OESER_RI         OS05         Yes         95352504         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         14.324         mg/kg           Upper creek         OESER_RI         OS06         Yes         95352505         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         14.324         mg/kg           Upper creek         OESER_RI         SD05         Yes         99070524         7/28/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.0407 J         mg/kg           Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.154105 J         mg/kg           Upper creek         OESER_RI         SD07         Yes         99070526         7/29/1999         0.0         0.5 ft         Surface Sediment         RI <t< td=""><td>South Slope</td><td></td><td></td><td>Yes</td><td></td><td></td><td></td><td></td><td>ft</td><td>Subsurface Soil</td><td></td><td></td><td></td><td>U</td><td>mg/kg</td></t<>	South Slope			Yes					ft	Subsurface Soil				U	mg/kg
Upper creek         OESER_RI         OS04         Yes         95352503         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         9.448         mg/kg           Upper creek         OESER_RI         OS05         Yes         95352504         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         14.324         mg/kg           Upper creek         OESER_RI         OS06         Yes         95352505         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         14.872         mg/kg           Upper creek         OESER_RI         SD05         Yes         99070524         7/28/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.04047 J         mg/kg           Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.154105 J         mg/kg           Upper creek         OESER_RI         SD07         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         <	Upper creek	OESER_RI	OS03	Yes	95352502	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	TEQBAP (ND = 1/2 DL)	5.5206		mg/kg
Upper creek   OESER_RI   OS05   Yes   95352504   11/171996   0.0   0.5   ft   Surface Sediment   ESI   TEQBAP (ND = 1/2 DL)   14.324   mg/kg		OESER_RI	OS04	Yes	95352503	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	TEQBAP (ND = 1/2 DL)	9.448		
Upper creek         OESER_RI         OSO6         Yes         95352505         1/1/1996         0.0         0.5 ft         Surface Sediment         ESI         TEQBAP (ND = 1/2 DL)         1.8472         mg/kg           Upper creek         OESER_RI         SD05         Yes         99070524         7/28/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.4047 J         mg/kg           Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.154105 J         mg/kg           Upper creek         OESER_RI         SD07         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01417 J         mg/kg           Upper creek         OESER_RI         SD08         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01417 J         mg/kg           Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI						1/1/1996			ft		ESI		14.324		
Upper creek         OESER_RI         SD05         Yes         99070524         7/28/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.4047 J         mg/kg           Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.154105 J         mg/kg           Upper creek         OESER_RI         SD07         Yes         99070526         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.337 J         mg/kg           Upper creek         OESER_RI         SD08         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01817 J         mg/kg           Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.06694 J         J         mg/kg									ft						
Upper creek         OESER_RI         SD06         Yes         99070525         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.154105 J         mg/kg           Upper creek         OESER_RI         SD07         Yes         99070526         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.337 J         mg/kg           Upper creek         OESER_RI         SD08         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01817 J         mg/kg           Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.08694 J         mg/kg		_							ft					.1	
Upper creek         OESER_RI         SD07         Yes         99070526         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.337 J         mg/kg           Upper creek         OESER_RI         SD08         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01817 J         mg/kg           Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.08694 J         J         mg/kg									ft					1	
Upper creek         OESER_RI         SD08         Yes         99070527         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         1.01817 J         mg/kg           Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.08694 J         mg/kg									n.					,	
Upper creek         OESER_RI         SD09         Yes         99070528         7/29/1999         0.0         0.5 ft         Surface Sediment         RI         TEQBAP (ND = 1/2 DL)         0.08694 J         J         mg/kg									π					J	
									π					J	
									ft		RI			J	
	Upper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	TEQBAP (ND = 1/2 DL)	2.593	J	mg/kg

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Upper creek	OESER_RI	MWLSC04	Yes	99070539	8/2/1999	12.0	14.0	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.002	U	mg/kg
• •	OESER_RI	MWLSC04	Yes	99070538	8/2/1999	4.0	6.0	ft		RI	TEQBAP (ND = 1/2 DL)	0.0021	U	mg/kg
	OESER_RI	MWLSC01	Yes	99070511	8/5/1999	0.0	0.2	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	0.021695	J	mg/kg
• •	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2	ft		RI	TEQBAP (ND = 1/2 DL)	0.017255	J	mg/kg
	OESER_RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0140455	J	mg/kg
	OESER_RI	MWLSC04	Yes	99070514	8/5/1999	0.0	0.5	ft		RI	TEQBAP (ND = 1/2 DL)	0.2803	J	mg/kg
Upper creek	OESER_RI	TT01-B	Yes	99070647	8/5/1999	6.0	6.0	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.003424		mg/kg
Upper creek	OESER_RI	TT01-BW	Yes	99070649	8/5/1999	2.5	2.5	ft		RI	TEQBAP (ND = 1/2 DL)	0.0019	U	mg/kg
Upper creek	OESER_RI	TT01-SW	Yes	99070648	8/5/1999	4.0	4.0	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.009149	J	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070540	8/6/1999	10.0	12.0	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0021	U	mg/kg
Upper creek	OESER_RI	SP01	Yes	99070650	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	8.133	J	mg/kg
Upper creek	OESER_RI	SP02	Yes	99070651	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	44.18	J	mg/kg
Upper creek	OESER_RI	SP03	Yes	99070652	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	4.052	J	mg/kg
Upper creek	OESER_RI	SP04	Yes	99070653	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0022	U	mg/kg
Upper creek	OESER_RI	SP05	Yes	99070654	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	1.605	J	mg/kg
Upper creek	OESER_RI	SP06	Yes	99070655	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQBAP (ND = 1/2 DL)	1.313	J	mg/kg
Upper creek	OESER RI	MWLSC01	Yes	99070541	06-Aug-99	18	20	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0024	U	mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070542	06-Aug-99	34	36	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0064715	J	mg/kg
• •	OESER_RI	MWLSC02	Yes	99070545	8/7/1999	10.0	12.0	ft		RI	TEQBAP (ND = 1/2 DL)	0.0021	U	mg/kg
	OESER_RI	MWLSC02	Yes	99070546	07-Aug-99	22	24	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0022	U	mg/kg
	OESER_RI	MWLSC03	Yes	99070543	07-Aug-99	28	30	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0024	U	mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070547	07-Aug-99	30	32	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0026	П	mg/kg
	OESER_RI	MWLSC03	Yes	99070544	07-Aug-99	32	34	ft	Subsurface Soil	RI	TEQBAP (ND = 1/2 DL)	0.0024	11	mg/kg
Upper creek	Ecology2003	LSC-04	Yes	3394043	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	TEQBAP (ND = 1/2 DL)	2.5147	1	mg/kg
	Ecology2003	LSC-04 LSC-06	Yes	3394045	9/25/2003	0.0	0.0		Surface Sediment	Ecology2003	TEQBAP (ND = 1/2 DL)	3.082	1	mg/kg
Upper creek		LSC-06 LSC-S2		3394048	9/25/2003	0.0	0.0				TEQBAP (ND = 1/2 DL)	1.2872	J	
Upper creek	Ecology2003 Integral RI	LSC-S2 LSC Bank	Yes Yes	LSP0051	11/7/2005	0.0	0.5	4	Surface Soil Surface Sediment	Ecology2003 LSP RI	TEQBAP (ND = 1/2 DL)	52.72	J	mg/kg
Upper creek								n.						mg/kg
Upper creek	Integral RI	SB-09	Yes Yes	LSP0176	2/6/2006	6.0	7.0	π	Subsurface Soil	LSP RI LSP RI	TEQBAP (ND = 1/2 DL)	2.292 6.987		mg/kg
Upper creek	Integral RI	SB-09		LSP0179	2/6/2006	9.0	10.0	π	Subsurface Soil		TEQBAP (ND = 1/2 DL)			mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0		Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	18.121		mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0178	2/6/2006	8.0	9.0		Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	26.97		mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0191	2/7/2006	6.0	7.0	tt .	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	1.645	J	mg/kg
Upper creek	Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	7.616		mg/kg
Upper creek	Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	13.79		mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0219	2/8/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.01788	J	mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0220	2/8/2006	5.0	6.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.0944		mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0223	2/8/2006	9.0	10.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.30355		mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0222	2/8/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	1.099		mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0221	2/8/2006	6.0	7.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	1.539		mg/kg
Upper creek	Integral RI	SB-14	Yes	LSP0226	2/9/2006	10.0	11.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.14965	J	mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0274	2/11/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	144	J	mg/kg
Upper creek	Integral RI	SB-11	Yes	LSP0275	2/11/2006	1.0	2.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	443.6		mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0324	14-Feb-06	25.5	27	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.01512	J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0325	14-Feb-06	27	28.5	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	4.405		mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0326	14-Feb-06	28.5	29.6	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	1.8315		mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0327	14-Feb-06	29.6	30	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.02772	J	mg/kg
Upper creek	Integral RI	SB-22	Yes	LSP0328	14-Feb-06	30	31	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.02	U	mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0464	4/6/2006	5.0	5.5	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	2.818		mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0474	4/6/2006	10.0	10.6	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	11.4		mg/kg
Upper creek	Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	21.94		mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0509	4/7/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.03119	J	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0514	4/7/2006	10.2	11.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	0.05889	J	mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0512	4/7/2006	9.6	10.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	6.495		mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0511	4/7/2006	9.0	9.6	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	9.7		mg/kg
Upper creek	Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0	ft	Subsurface Soil	LSP RI	TEQBAP (ND = 1/2 DL)	28.22		mg/kg
	OESER_RI	OS07	Yes	95352506	1/1/1996	0.0	0.5	ft	Surface Sediment	ESI	TEQBAP (ND = 1/2 DL)	0.185	U	mg/kg
	OESER_RI	SD11	Yes	99070530	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	TEQBAP (ND = 1/2 DL)	0.103	Ū.	mg/kg
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Wetlands	Ecology2003	LSC-05	Yes	3394044	9/25/2003	0.0	0.0			Ecology2003	TEQBAP (ND = 1/2 DL)	0.196	ш	mg/kg

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

#### Key:

bgs = below ground surface

PAH = polycyclic aromatic hydrocarbon

#### Available carcinogenic PAH screening values (see Table SV-1 notes on applicability):

EPA Region 6 RBC - Residential 0.062 mg/kg MTCA Method B Direct Contact 0.137 mg/kg Recreational Use Screening Value (10-6 cancer risk) 4.5 mg/kg Recreational Use Screening Value (10-4 cancer risk) 453 mg/kg

Ecology and Environment, Inc. 3/6/2008

#### DRAFT - FOR EPA USE ONLY

Table HH-9. Dioxin/Furan Results (as 2,3,7,8-TCDD Toxic Equivalent Concentration) for Soil and Sediment at Little Squalicum Park¹.

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Site Area	Event	Location	On Site	Sample ID	Sampling Date			Depth Unit	Matrix	Source	Analyte	Result	Qualifier	Units
General Site	OESER_RI	RES-47A	Yes	99224036	5/26/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	2.55E-06		mg/kg
General Site	OESER_RI	RES-48	Yes	99224034	5/26/1999	0.0	0.2	1	Surface Soil	RI	TEQDF 0.5M05	6.60E-06		mg/kg
General Site	OESER_RI	RES-49	Yes	99224035	5/26/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	5.80E-06		mg/kg
General Site	OESER_RI	SP07	Yes	99070656	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.88E-03		mg/kg
Historical creek	Integral RI	TP-16	Yes	LSP0088	11/16/2005	0.0	2.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.33E-03	J	mg/kg
Historical creek	Integral RI	TP-17	Yes	LSP0090	11/16/2005	1.0	2.0	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	3.59E-04	J	mg/kg
Historical creek	Integral RI	SB-35	Yes	LSP0546	4/10/2006	1.0	1.8	ft	Subsurface Sediment	LSP RI	TEQDF 0.5M05	2.45E-03	J	mg/kg
Historical creek	Integral RI	SB-36	Yes	LSP0548	4/10/2006	0.0	0.8	ft	Surface Sediment	LSP RI	TEQDF 0.5M05	3.29E-03	J	mg/kg
Historical creek	Integral RI	SB-37	Yes	LSP0552	4/10/2006	0.0	1.2	ft	Surface Sediment	LSP RI	TEQDF 0.5M05	1.50E-03	J	mg/kg
Historical creek	Integral RI	SB-38	Yes	LSP0561	4/11/2006	0.0	1.0	ft	Surface Sediment	LSP RI	TEQDF 0.5M05	6.86E-04	J	mg/kg
Lower creek	OESER_RI	SD01	Yes	99070520	7/28/1999	0.0	0.5	ft	Surface Sediment	RI	TEQDF 0.5M05	1.17E-05		mg/kg
Lower creek	OESER_RI	SD02	Yes	99070521	7/28/1999	0.0	0.5	ft	Surface Sediment	RI	TEQDF 0.5M05	2.19E-04		mg/kg
Lower creek	OESER_RI	SD03	Yes	99070522	7/28/1999	0.0	0.5	ft	Surface Sediment	RI	TEQDF 0.5M05	2.34E-04		mg/kg
Lower creek	OESER_RI	SD04	Yes	99070523	7/28/1999	0.0	0.5	ft	Surface Sediment	RI	TEQDF 0.5M05	2.83E-05		mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0127	2/2/2006	1.0	2.0	ft	Subsurface Sediment	LSP RI	TEQDF 0.5M05	4.70E-03	J	mg/kg
Lower creek	Integral RI	SB-02	Yes	LSP0132	2/2/2006	0.0	1.0	ft	Surface Sediment	LSP RI	TEQDF 0.5M05	5.94E-03	J	mg/kg
Lower creek	Integral RI	SB-18	Yes	LSP0250	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.13E-03	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0254	2/10/2006	3.0	3.6	ft	Subsurface Sediment	LSP RI	TEQDF 0.5M05	1.10E-03	J	mg/kg
Lower creek	Integral RI	SB-19	Yes	LSP0264	2/10/2006	1.0	2.0	ft	Subsurface Sediment	LSP RI	TEQDF 0.5M05	1.49E-03	J	mg/kg
Lower creek	Integral RI	SB-20	Yes	LSP0271	2/10/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.58E-03	J	mg/kg
South Slope	OESER_RI	RES-43	Yes	99224021	5/25/1999	0.0	0.2	ft	Surface Soil	RI	TEQDF 0.5M05	7.81E-05		mg/kg
South Slope	OESER_RI	RES-46	Yes	99224022	5/25/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	5.13E-06		mg/kg
South Slope	OESER RI	B-AA2	Yes	99070532	8/3/1999	0.0	0.2	1	Surface Soil	RI	TEQDF 0.5M05	1.08E-05		mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070533	8/3/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	7.25E-06		mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070534	8/3/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	9.44E-06		mg/kg
South Slope	OESER_RI	B-BB3	Yes	99070535	8/3/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	6.86E-06		mg/kg
South Slope	OESER RI	B-BB5	Yes	99070536	8/3/1999	0.0	0.2	1	Surface Soil	RI	TEQDF 0.5M05	4.69E-06		mg/kg
South Slope	OESER_RI	B-AA2	Yes	99070587	8/5/1999	6.0	8.0	1	Subsurface Soil	RI	TEQDF 0.5M05	5.61E-06		mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070589	8/5/1999	6.0	8.0	1	Subsurface Soil	RI	TEQDF 0.5M05	4.11E-06		mg/kg
South Slope	OESER_RI	B-AA6	Yes	99070591	8/5/1999	6.0	8.0		Subsurface Soil	RI	TEQDF 0.5M05	1.13E-05		mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070590	8/5/1999	18	20	1	Subsurface Soil	RI	TEQDF 0.5M05	1.86E-05		mg/kg
South Slope	OESER_RI	B-AA4	Yes	99070588	8/5/1999	36	38		Subsurface Soil	RI	TEQDF 0.5M05	2.24E-06		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070593	8/6/1999	4.0	6.0	1	Subsurface Soil	RI	TEQDF 0.5M05	1.45E-05		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070594	8/6/1999	16	18	1	Subsurface Soil	RI	TEQDF 0.5M05	1.25E-05		mg/kg
South Slope	OESER_RI	B-BB5	Yes	99070595	8/6/1999	18	20	1	Subsurface Soil	RI	TEQDF 0.5M05	1.05E-05		mg/kg
Upper creek	OESER_RI	SD05	Yes	99070524	7/28/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	3.85E-05		mg/kg
Upper creek	OESER_RI	SD06	Yes	99070525	7/29/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	3.84E-04		mg/kg
Upper creek	OESER_RI	SD07	Yes	99070526	7/29/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	6.57E-05		mg/kg
Upper creek	OESER_RI	SD08	Yes	99070527	7/29/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	1.59E-04		mg/kg
Upper creek	OESER_RI	SD09	Yes	99070528	7/29/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	1.26E-05		mg/kg
Upper creek	OESER_RI	SD10	Yes	99070529	7/29/1999	0.0	0.5	1	Surface Sediment	RI	TEQDF 0.5M05	7.31E-04		mg/kg
Upper creek	OESER_RI	MWLSC01	Yes	99070529	8/5/1999	0.0	0.3	1	Surface Soil	RI	TEQDF 0.5M05	2.94E-05		mg/kg
Upper creek	OESER_RI	MWLSC02	Yes	99070511	8/5/1999	0.0	0.2	1	Surface Soil	RI	TEQDF 0.5M05	2.36E-05		mg/kg
	OESER_RI	MWLSC02	Yes	99070512	8/5/1999	0.0	0.2		Surface Soil	RI	TEQDF 0.5M05	1.40E-05		1
Upper creek	OESER_RI	MWLSC03	Yes	99070513	8/5/1999	0.0	0.5	1	Surface Soil	RI	TEQDF 0.5M05	1.40E-05 1.27E-04		mg/kg
Upper creek	OESER_RI	TT01-BW	Yes	99070514	8/5/1999	2.5	2.5	1	Subsurface Soil	RI	TEQDF 0.5M05	8.50E-07		mg/kg
Upper creek		SP01	-			0.0		1				1		mg/kg
Upper creek	OESER_RI		Yes	99070650	8/6/1999		0.5	1	Surface Soil	RI	TEQDF 0.5M05	1.93E-04		mg/kg
Upper creek	OESER_RI	SP02	Yes	99070651	8/6/1999	0.0	0.5	π	Surface Soil	RI	TEQDF 0.5M05	1.37E-03		mg/kg

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OESER_RI	SP03	Yes	99070652	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	9.87E-04	mg/kg
OESER_RI	SP04	Yes	99070653	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	1.49E-06	mg/kg
OESER_RI	SP05	Yes	99070654	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	4.01E-04	mg/kg
OESER_RI	SP06	Yes	99070655	8/6/1999	0.0	0.5	ft	Surface Soil	RI	TEQDF 0.5M05	3.32E-04 J	mg/kg
OESER_RI	MWLSC01	Yes	99070541	8/6/1999	18	20	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.38E-06	mg/kg
OESER_RI	MWLSC03	Yes	99070544	8/7/1999	32	34	ft	Subsurface Soil	RI	TEQDF 0.5M05	1.39E-05 U	mg/kg
Integral RI	SB-09	Yes	LSP0177	2/6/2006	7.0	8.0	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	2.32E-05 J	mg/kg
Integral RI	SB-12	Yes	LSP0201	2/7/2006	4.0	5.0	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	3.90E-04 J	mg/kg
Integral RI	SB-09	Yes	LSP0213	2/8/2006	0.0	1.0	ft	Surface Soil	LSP RI	TEQDF 0.5M05	1.68E-04 J	mg/kg
Integral RI	SB-29	Yes	LSP0468	4/6/2006	7.0	7.3	ft	Subsurface Soil	LSP RI	TEQDF 0.5M05	1.04E-04 J	mg/kg
Integral RI	SB-31	Yes	LSP0510	4/7/2006	8.0	9.0		Subsurface Soil	LSP RI	TEQDF 0.5M05	4.04E-04 J	mg/kg
OESER_RI	SD11	Yes	99070530	7/29/1999	0.0	0.5	ft	Surface Sediment	RI	TEQDF 0.5M05	7.56E-06	mg/kg
	OESER_RI OESER_RI OESER_RI OESER_RI OESER_RI Integral RI	OESER_RI   SP04	OESER_RI         SP04         Yes           OESER_RI         SP05         Yes           OESER_RI         SP06         Yes           OESER_RI         MWLSC01         Yes           OESER_RI         MWLSC03         Yes           Integral RI         SB-09         Yes           Integral RI         SB-12         Yes           Integral RI         SB-09         Yes           Integral RI         SB-29         Yes           Integral RI         SB-31         Yes	OESER_RI         SP04         Yes         99070653           OESER_RI         SP05         Yes         99070654           OESER_RI         SP06         Yes         99070655           OESER_RI         MWLSC01         Yes         99070541           OESER_RI         MWLSC03         Yes         99070544           Integral RI         SB-09         Yes         LSP0177           Integral RI         SB-12         Yes         LSP0201           Integral RI         SB-09         Yes         LSP0213           Integral RI         SB-29         Yes         LSP0468           Integral RI         SB-31         Yes         LSP0510	OESER_RI SP04 Yes 99070653 8/6/1999 OESER_RI SP05 Yes 99070654 8/6/1999 OESER_RI SP06 Yes 99070655 8/6/1999 OESER_RI SP06 Yes 99070655 8/6/1999 OESER_RI MWLSC01 Yes 99070541 8/6/1999 OESER_RI MWLSC03 Yes 99070544 8/7/1999 Integral RI SB-09 Yes LSP0177 2/6/2006 Integral RI SB-09 Yes LSP0201 2/7/2006 Integral RI SB-09 Yes LSP0213 2/8/2006 Integral RI SB-29 Yes LSP0468 4/6/2006 Integral RI SB-31 Yes LSP0510 4/7/2006	OESER_RI         SP04         Yes         99070653         8/6/1999         0.0           OESER_RI         SP05         Yes         99070654         8/6/1999         0.0           OESER_RI         SP06         Yes         99070655         8/6/1999         0.0           OESER_RI         MWLSC01         Yes         99070541         8/6/1999         18           OESER_RI         MWLSC03         Yes         99070544         8/7/1999         32           Integral RI         SB-09         Yes         LSP0177         2/6/2006         7.0           Integral RI         SB-12         Yes         LSP0201         2/7/2006         4.0           Integral RI         SB-09         Yes         LSP0213         2/8/2006         0.0           Integral RI         SB-29         Yes         LSP0468         4/6/2006         7.0           Integral RI         SB-31         Yes         LSP0510         4/7/2006         8.0	OESER_RI         SP04         Yes         99070653         8/6/1999         0.0         0.5           OESER_RI         SP05         Yes         99070654         8/6/1999         0.0         0.5           OESER_RI         SP06         Yes         99070655         8/6/1999         0.0         0.5           OESER_RI         MWLSC01         Yes         99070541         8/6/1999         18         20           OESER_RI         MWLSC03         Yes         99070544         8/7/1999         32         34           Integral RI         SB-09         Yes         LSP0177         2/6/2006         7.0         8.0           Integral RI         SB-12         Yes         LSP0201         2/7/2006         4.0         5.0           Integral RI         SB-09         Yes         LSP0213         2/8/2006         0.0         1.0           Integral RI         SB-29         Yes         LSP0468         4/6/2006         7.0         7.3           Integral RI         SB-31         Yes         LSP0510         4/7/2006         8.0         9.0	OESER_RI   SP04   Yes   99070653   8/6/1999   0.0   0.5   ft	OESER_RI         SP04         Yes         99070653         8/6/1999         0.0         0.5 ft         Surface Soil           OESER_RI         SP05         Yes         99070654         8/6/1999         0.0         0.5 ft         Surface Soil           OESER_RI         SP06         Yes         99070655         8/6/1999         0.0         0.5 ft         Surface Soil           OESER_RI         MWLSC01         Yes         99070541         8/6/1999         18         20 ft         Subsurface Soil           OESER_RI         MWLSC03         Yes         99070544         8/7/1999         32         34 ft         Subsurface Soil           Integral RI         SB-09         Yes         LSP0177         2/6/2006         7.0         8.0 ft         Subsurface Soil           Integral RI         SB-12         Yes         LSP0201         2/7/2006         4.0         5.0 ft         Subsurface Soil           Integral RI         SB-09         Yes         LSP0213         2/8/2006         0.0         1.0 ft         Surface Soil           Integral RI         SB-29         Yes         LSP0468         4/6/2006         7.0         7.3 ft         Subsurface Soil           Integral RI         SB-31         Yes <td>  OESER_RI   SP04   Yes   99070653   8/6/1999   0.0   0.5 ft   Surface Soil   RI    </td> <td>OESER_RI         SP04         Yes         99070653         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         SP05         Yes         99070654         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         SP06         Yes         99070655         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         MWLSC01         Yes         99070541         8/6/1999         18         20 ft         Subsurface Soil         RI         TEQDF 0.5M05           OESER_RI         MWLSC03         Yes         99070544         8/7/1999         32         34 ft         Subsurface Soil         RI         TEQDF 0.5M05           Integral RI         SB-09         Yes         LSP0177         2/6/2006         7.0         8.0 ft         Subsurface Soil         LSP RI         TEQDF 0.5M05           Integral RI         SB-12         Yes         LSP0201         2/7/2006         4.0         5.0 ft         Subsurface Soil         LSP RI         TEQDF 0.5M05           Integral RI         SB-09         Yes         LSP0213         2/8/2006         0.0</td> <td>  OESER_RI   SP04   Yes   99070653   8/6/1999   0.0   0.5 ft   Surface Soil   RI   TEQDF 0.5M05   1.49E-06    </td>	OESER_RI   SP04   Yes   99070653   8/6/1999   0.0   0.5 ft   Surface Soil   RI	OESER_RI         SP04         Yes         99070653         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         SP05         Yes         99070654         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         SP06         Yes         99070655         8/6/1999         0.0         0.5 ft         Surface Soil         RI         TEQDF 0.5M05           OESER_RI         MWLSC01         Yes         99070541         8/6/1999         18         20 ft         Subsurface Soil         RI         TEQDF 0.5M05           OESER_RI         MWLSC03         Yes         99070544         8/7/1999         32         34 ft         Subsurface Soil         RI         TEQDF 0.5M05           Integral RI         SB-09         Yes         LSP0177         2/6/2006         7.0         8.0 ft         Subsurface Soil         LSP RI         TEQDF 0.5M05           Integral RI         SB-12         Yes         LSP0201         2/7/2006         4.0         5.0 ft         Subsurface Soil         LSP RI         TEQDF 0.5M05           Integral RI         SB-09         Yes         LSP0213         2/8/2006         0.0	OESER_RI   SP04   Yes   99070653   8/6/1999   0.0   0.5 ft   Surface Soil   RI   TEQDF 0.5M05   1.49E-06

Source: Ecology and Environment, Inc. (E&E), March 2008.

#### Notes:

1. Data from March 2007 version of Little Squalicum Park (averaged) database prepared by Integral Consulting.

#### Key:

bgs = below ground surface
TCDD = Tetrachlorodibenzo-p-dioxin

#### Available TCDD screening values (see Table SV-1 notes on applicability):

EPA Region 6 RBC - Residential	3.9E-06	mg/kg
MTCA Method B Direct Contact	6.7E-06	mg/kg
Recreational Use Screening Value (10-6 cancer risk)	2.7E-04	mg/kg
Recreational Use Screening Value (10-4 cancer risk)	2.7E-02	mg/kg



## **B** Volume Calculations



#### **Table B1. Summary of Volume Calculations**

Alternative 2: Excavation and Offsite Disposal or Consolidation on the Oeser Property

Site Area	Excavation Volume for Offsite Disposal (CY)	Volume of Clean Backfill Required (CY)	
Existing Creek Channel	2,754	2,754	
Existing Creek Channel (Area DS of Box Culvert)	380	380	
Historical Creek Channel	6,979	6,979	
Total:	10,113	10,113	

Alternative 3: Excavation, Consolidation, Capping, and Creek Reroute

Site Area	Contaminated Material Excavation Volume (CY)	Clean Material Excavation Volume (CY)		Volume of Excavated Contaminated Material to Fill and Place Along Middle Reach of Existing Channel (CY)	Cap Material Required (CY)
Existing Creek Channel (Upper and Lower Reach)	1,380		1,380		
Existing Creek Channel (Middle Reach)				1,760	3,884
Existing Creek Channel (Area DS of Box Culvert)	380		380		
Historical Creek Channel					4,756
New Upper Creek Channel		3,025			
Total:	1,760	3,025	1,760	1,760	8,641
Volume of Clean Materi	al to be Excavat	ed from Estuary Area (CY):	/ 3/5		

Alternative 4: Excavation, Consolidation, Capping, and Creek Reroute back through the Historical Creek Channel

Site Area	Contaminated Material Excavation Volume (CY)	Clean Material Excavation Volume (CY)		Volume of Excavated Contaminated Material to Fill and Place Along Middle Reach of Existing Channel (CY)	Cap Material Required (CY)
Existing Creek Channel (Upper and Lower Reach)	1,380		1,380		
Existing Creek Channel (Middle Reach)				5,272	5,701
Existing Creek Channel (Area DS of Box Culvert)	380		380		
Historical Creek Channel (Lower Reach)	2,593				
Historical Creek Channel (Upper Reach)					1,274
New Upper Creek Channel (Lower Historical Creek Channel Reoccupied)	919	1,471			
Total:	0,2,2	1,471	1,760	5,272	6,976
Volume of Clean Materia	ai to be Excavat	ed from Estuary Area (CY):	7 764		

Alternative 5: Excavation, Consolidation, Capping, and Long Creek Reroute back through the Historical Creek Channel

Site Area	Contaminated Material Excavation Volume (CY)	Clean Material Excavation Volume (CY)		Volume of Excavated Contaminated Material to Fill and Place Along Middle Reach of Existing Channel (CY)	Cap Material Required (CY)
Existing Creek Channel					
(Upper, Middle and Lower	601		601		
Reach)					
Existing Creek Channel				8,071	7,303
(Middle Reach)				0,071	7,505
Existing Creek Channel	380		380		
(Area DS of Box Culvert)	300		300		
Existing Creek Channel					262
(Lower Reach)					202
Historical Creek Channel	6,979		4,387		
New Creek Channel (Lower					
Historical Creek Channel	110	6,715			
Reoccupied)					
Total:	- / -	6,715	5,368	8,071	7,566
Volume of Clean Materia	al to be Excavate	ed from Estuary	6,218		
		Area (CY):	0,210		

## **Notes and Assumptions:**

- 1. For Alternative 2, it is assumed that clean backfill material will be excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.
- 2. For Alternatives 3, 4 and 5, it is assumed that material excavated from the new creek channel is clean, and will be used as backfill and cap material. Additional clean backfill material will be excavated from the estuary area.
- 3. For Alternatives 3, 4 and 5, excavated contaminated material will be placed within the middle reach of the existing creek channel prior to capping.
- 4. For Alternative 4, it is assumed that material excavated from the new upper creek channel, STA 100+00 E to STA 103+00 E, is clean and will be used as backfill and cap material. For Alternative 5, it is assumed that material excavated from the creek channel, STA 200+00 F to STA 212+00 F and STA 221+50 F to 227+00 F, is clean and will be used as backfill and cap material.

Table B2. Alternative 2 - Volume Calculation for the Excavation of Contaminated

Soil/Sediment from the Existing Creek Channel

Station	Cross Section	Depth of Excavation (ft)	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
10+00 A	11+50 A	6	114		
11+50 A BACK	11+50 A	6	114	150	17,100
11+50 A AHD	11+50 A	6	114		
13+00 A BACK	11+50 A	6	114	150	17,100
13+00 A AHD	14+50 A	6	90		
13+62 A BACK	14+50 A	6	90	62	5,580
13+62 A AHD	14+50 A	1	15		
14+50 A BACK	14+50 A	1	15	88	1,320
14+50 A AHD	14+50 A	1	15		
17+00 A BACK	14+50 A	1	15	250	3,750
17+00 A AHD	19+50 A	1	17		
19+50 A BACK	19+50 A	1	17	250	4,250
19+50 A AHD	19+50 A	1	17		
19+55 A BACK	19+50 A	1	17	5	85
19+55 A AHD	19+50 A	4	68		
21+00 A BACK	19+50 A	4	68	145	9,860
21+00 A AHD	22+50 A	4	68		
22+00 A BACK	22+50 A	4	68	100	6,800
22+00 A AHD	22+50 A	1	17		
22+50 A BACK	22+50 A	1	17	50	850
22+50 A AHD	22+50 A	1	17		
23+38 A BACK	22+50 A	1	17	88	1,496
23+38 A AHD	24+25 A	1	18		
24+25 A BACK	24+25 A	1	18	87	1,566
24+25 A AHD	24+25 A	1	18		
24+50 A BACK	24+25 A	1	18	25	450
24+50 A AHD	24+25 A	2	36		
25+65 A	24+25 A	2	36	115	4,140
				Total:	74,347
				Total (CY):	2,754

#### Notes and Assumptions:

- 1. Volume calculated using the Average-End-Area Method along Alignment A with five cross sections and four excavation lines.
- 2. The following excavation lines were used for the existing creek channel. Excavation lines indicate the transition between different depths of excavation.

Excavation Line A at STA 13+62 A Excavation Line B at STA 19+55 A Excavation Line C at STA 22+00 A Excavation Line D at STA 24+50 A

- 3. Along Alignment A, assume excavation will extend 5 feet beyond the surveyed creek extent on each side.
- 4. Cross-sectional perimeters per AutoCAD (in feet):

11+50 A: 19 14+50 A: 15 19+50 A: 17 22+50 A: 17 24+25 A: 18

5. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

Table B3. Alternatives 2 and 5 - Volume Calculation for the Excavation of Contaminated Soil/Sediment from the Historical Creek Channel

		Depth of	Cross-		Volume
Station	<b>Cross Section</b>	Excavation	Sectional Area	Length (ft)	
		(ft)	(SF)		(CF)
30+00 B	30+20 B	6	624		
30+20 B BACK	30+20 B	6	624	20	12,480
30+20 B AHD	30+20 B	6	624		
31+60 B BACK	30+20 B	6	624	140	87,360
31+60 B AHD	33+00 B	6	186		
32+60 B BACK	33+00 B	6	186	100	18,600
32+60 B AHD	33+00 B	2	62		
33+00 B BACK	33+00 B	2	62	40	2,480
33+00 B AHD	33+00 B	2	62		
34+13 B BACK	33+00 B	2	62	113	7,006
34+13 B AHD	35+25 B	2	162		
35+25 B BACK	35+25 B	2	162	112	18,144
35+25 B AHD	35+25 B	2	162		
36+63 B BACK	35+25 B	2	162	138	22,356
36+63 B AHD	38+00 B	2	66		
38+00 B BACK	38+00 B	2	66	137	9,042
38+00 B AHD	38+00 B	2	66		
38+46 B BACK	38+00 B	2	66	46	3,036
38+46 B AHD	38+00 B	1	33		
39+00 B BACK	38+00 B	1	33	54	1,782
39+00 B AHD	40+00 B	1	40		
40+00 B BACK	40+00 B	1	40	100	4,000
40+00 B AHD	40+00 B	1	40		
40+54 B	40+00 B	1	40	54	2,160
				Total:	188,446
				Total (CY):	6,979

- 1. Volume calculated using the Average-End-Area Method along Alignment B with five cross sections and two excavation lines.
- 2. Excavation lines indicate the transition between different depths of excavation.

Excavation Line E at STA 32+60 B

Excavation Line F at STA 38+46 B

- 3. Along Alignment B, assume excavation will extend 5 feet beyond the "Extent of Historical Creek" on each side. The historical creek extent was estimated by Integral Consulting Inc. during the Little Squalicum Park Remedial Investigation based on existing topography, field observations, and historic aerial photos provided by the City of Bellingham and US EPA (Integral 2008).
- 4. Cross-sectional perimeters per AutoCAD (in feet):

30+20 B: 104 33+00 B: 31 35+25 B: 81 38+00 B: 33 40+00 B: 40

5. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

CY = cubic yards

#### References:

Integral Consulting Inc. (Integral). 2008. Little Squalicum Park Remedial Investigation, Bellingham, Washington. Draft Final Report.

Table B4. Alternatives 2, 3, 4 and 5 - Volume Calculation for the Excavation of Contaminated Soil/Sediment from the Area Downstream of the Box Culvert

Station	Cross Section	Depth of Excavation (ft)	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
90+00 A2	90+10 A2	6	102		
90+30 A2 BACK	90+10 A2	6	102	30	3,060
90+30 A2 AHD	90+50 A2	6	150		
90+78 A2	90+50 A2	6	150	48	7,200
	10,260				
				Total (CY):	380

- 1. Volume calculated using the Average-End-Area Method along Alignment A2 with two cross sections.
- 2. Along Alignment A2, assume excavation will extend 8 feet beyond the alignment on each side to be consistent with the width obtained for the existing creek channel excavation.
- 3. Cross-sectional perimeters per AutoCAD (in feet):

90+10 A2: 17 90+50 A2: 25

4. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

Table B5. Alternatives 3 and 4 - Volume Calculation for the Excavation of Contaminated Soil/Sediment from the Upper and Lower Reaches of the Existing Creek Channel

Station	Cross Section	Depth of Excavation (ft)	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
10+00 A	10+50 A	6	90		
10+50 A BACK	10+50 A	6	90	50	4,500
10+50 A AHD	10+50 A	6	90		
11+00 A	10+50 A	6	90	50	4,500
17+73 A	19+50 A	1	17		
19+50 A BACK	19+50 A	1	17	177	3,009
19+50 A AHD	19+50 A	1	17		
19+55 A BACK	19+50 A	1	17	5	85
19+55 A AHD	19+50 A	4	68		
21+00 A BACK	19+50 A	4	68	145	9,860
21+00 A AHD	22+50 A	4	68		
22+00 A BACK	22+50 A	4	68	100	6,800
22+00 A AHD	22+50 A	1	17		
22+50 A BACK	22+50 A	1	17	50	850
22+50 A AHD	22+50 A	1	17		
23+38 A BACK	22+50 A	1	17	88	1,496
22+38 A AHD	24+25 A	1	18		
24+25 A BACK	24+25 A	1	18	87	1,566
24+25 A AHD	24+25 A	1	18		
24+50 A BACK	24+25 A	1	18	25	450
24+50 A AHD	24+25 A	2	36		
25+65 A	24+25 A	2	36	115	4,140
				Total:	37,256
				Total (CY):	1,380

- 1. Volume calculated using the Average-End-Area Method along Alignment A with four cross sections. Calculation includes the upper reach of the existing creek channel (STA 10+00 A to 11+00 A) and the lower reach of the existing creek channel (STA 17+73 A to 25+65 A), excluding the cap/repository area in between.
- 2. The following excavation lines were used for the lower reach of the existing creek channel. Excavation lines indicate the transition between different depths of excavation.

Excavation Line B at STA 19+55 A Excavation Line C at STA 22+00 A Excavation Line D at STA 24+50 A

- 3. Along Alignment A, assume excavation will extend 5 feet beyond the surveyed creek extent on each side.
- 4. Cross-sectional perimeters per AutoCAD (in feet):

10+50 A: 15 19+50 A: 17 22+50 A: 17 24+25 A: 18

5. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

Table B6. Alternative 3 - Volume Calculation for the Excavation of the New Upper Creek Channel

		1		
Station	Cross Section	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
80+00 D	80+50 D	114		
80+75 D BACK	80+50 D	114	75	8,586
80+75 D AHD	81+00 D	83		
81+50 D BACK	81+00 D	83	75	6,244
81+50 D AHD	82+00 D	35		
82+82 D BACK	82+00 D	35	132	4,669
82+82 D AHD	83+50 D	24		
84+63 D BACK	83+50 D	24	181	4,295
84+63 D AHD	85+50 D	38		
87+13 D BACK	85+50 D	38	250	9,380
87+13 D AHD	88+50 D	222		
89+32 D	88+50 D	222	219	48,513
			Total:	81,687
			Total (CY):	3,025

- 1. Volume calculated using the Average-End-Area Method along Alignment D with six cross sections.
- 2. The typical cross section of the new upper creek channel is assumed to be a trapezoid with the following:

Area of Trapezoid = (1/2)(bottom width + top width)(height)

Side slope: 3H:1V Bottom width: 5 feet

Height: (surface elevation) - (bottom elevation per AutoCAD)

3. To calculate the new upper creek channel slope:

Upstream surface elevation (historical channel): 33 feet NAVD 1988

Downstream surface elevation (historical channel): 19 feet NAVD 1988

Length of new channel: 932 feet therefore:

New channel slope: 0.015

4. To determine the height (excavation depth) at each cross section, a profile line (along Alignment D) and a grade line with a 0.015 ft/ft slope were drawn in AutoCAD. The grade line was drawn so that there would be approximately 2 feet or more below the low point of the profile line. The excavation depth at each cross section was calculated as the difference between the surface elevation (profile line) and bottom elevation (grade line).

5. Calculated cross section height (in feet):

80+50 D: 5.4 81+00 D: 4.5 82+00 D: 2.7 83+50 D: 2.1 85+50 D: 2.8 88+50 D: 7.8

6. Excavated soil is assumed to be clean and suitable for use as cap material in other areas of the site.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

Table B7. Alternative 3 - Volume Calculation for Fill and Cap Material for the Middle Reach of the Existing Creek Channel

Station	Cross Section	Cross- Sectional Area to Fill with Excavated Contaminated Material (SF)	Cross-Sectional Area of Excavated Contaminated Material to be Placed Along Middle Reach (SF)	Sectional Area (SF)	Length (ft)	Volume to be Filled with Excavated Contaminated Material (CF)	Volume of Excavated Contaminated Material to be Placed Along Middle Reach (CF)	Volume of Cap Material (CF)
11+00 A	11+50 A	17	62	176				
13+00 A BACK	11+50 A	17	62	176	200	3,400	12,309	35,293
13+00 A AHD	14+50 A	4	62	142				
17+00 A BACK	14+50 A	4	62	142	400	1,600	24,619	56,698
17+00 A AHD	19+50 A	15	62	176				
17+73 A	19+50 A	15	62	176	73	1,095	4,493	12,882
					Total:	6,095	41,421	104,872
					Total (CY):	226	1,534	3,884

- 1. Volume calculated using the Average-End-Area Method along Alignment A for the middle reach of the existing creek channel, which starts at STA 11+00 A and ends at STA 17+73 A.
- 2. Along Alignment A, assume full thickness of cap will extend 5 feet beyond the surveyed creek extent on each side, and then taper down at a slope of 3H:1V.
- 3. Prior to capping, the middle reach of the existing creek channel will be filled with contaminated material excavated from the upper and lower reach of the existing creek channel and area downstream of the box culvert.
- 4. Cross-sectional areas to be filled per AutoCAD (in square feet):

11+50 A: 17 14+50 A: 4 19+50 A: 15

5. Volume of excavated material remaining to be placed along the length of the middle reach above the filled channel:

Volume (in CF): 41,421

6. The remaining excavated contaminated material will be placed along the length of the middle reach above the filled channel with a typical cross section of a rectangle. The height of the rectangle at each cross section was calculated with the following:

Volume = base x height x length

11+50 A: 5.1 14+50 A: 4.1 19+50 A: 5.1

7. The typical cross section of the cap is assumed to have:

Depth: 2 feet over excavated contaminated material

Side slope: 3H:1V

8. Cross-sectional perimeters for capping (after filled) per AutoCAD (in feet):

11+50 A: 12 14+50 A: 15 19+50 A: 12

9. Cap cross-sectional areas (before subtracting cross-sectional area of excavated contaminated material placed along the middle reach) (in square feet):

11+50 A: 238 14+50 A: 203 19+50 A: 238

#### Abbreviation:

 $\begin{array}{ll} \text{ft =} & \text{feet} \\ \text{SF =} & \text{square feet} \\ \text{CF =} & \text{cubic feet} \\ \text{CY =} & \text{cubic yards} \end{array}$ 

Table B8. Alternative 3 - Volume Calculation for Cap Material for the Historical Creek Channel

Onamici				1
Station	Cross Section	Cap Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
30+00 B	30+20 B	218		
31+60 B BACK	30+20 B	218	160	34,880
31+60 B AHD	33+00 B	74		
32+15 B BACK	33+00 B	74	55	4,070
32+33 B AHD	33+00 B	74		
34+13 B BACK	33+00 B	74	180	13,320
34+13 B AHD	35+25 B	174		
36+63 B BACK	35+25 B	174	250	43,500
36+63 B AHD	38+00 B	78		
39+00 B BACK	38+00 B	78	237	18,486
39+00 B AHD	40+00 B	92		
40+54 B	40+00 B	92	154	14,168
			Total:	128,424
			Total (CY):	4,756

- 1. Volume calculated using the Average-End-Area Method along Alignment B with five cross sections.
- 2. Along Alignment B, assume full thickness of cap will extend 5 feet beyond the "Extent of Historical Creek" on each side, and then taper down at a slope of 3H:1V.
- 3. The typical cross section of the cap is assumed to have:

Depth: 2 feet Side slope: 3H:1V

4. Cross-sectional perimeters for capping per AutoCAD (in feet):

30+20 B: 103 33+00 B: 31 35+25 B: 81 38+00 B: 33 40+00 B: 40

- 5. The historical creek channel and new upper creek channel intersect at STA 32+24 B (along Alignment B) and STA 64+64 C (along Alignment C). No cap is needed at this intersection.
- 6. To calculate the length along Alignment B to subtract from the volume, cross section 65+00 C is used, where:

Depth: 2.3 feet Bottom width: 5 feet

Side slope: 3H:1V therefore:

Length to subtract (feet): 18.8

7. Therefore, the cap stops at STA 32+15 B and restarts at STA 32+33 B (approximately).

#### Abbreviation:

 $\begin{array}{ll} \text{ft} = & \text{feet} \\ \text{SF} = & \text{square feet} \\ \text{CF} = & \text{cubic feet} \\ \text{CY} = & \text{cubic yards} \end{array}$ 

Table B9. Alternative 4 - Volume Calculation for the Excavation of Contaminated Soil/Sediment from the Lower Reach of the Historical Creek Channel

		Depth of	Cross-		Valuma
Station	<b>Cross Section</b>	=xouration	Sectional Area	Length (ft)	Volume (CF)
		(ft)	(SF)		(0.)
32+60 B	33+00 B	2	62		
33+00 B BACK	33+00 B	2	62	40	2,480
33+00 B AHD	33+00 B	2	62		
34+13 B BACK	33+00 B	2	62	113	7,006
34+13 B AHD	35+25 B	2	162		
35+25 B BACK	35+25 B	2	162	112	18,144
35+25 B AHD	35+25 B	2	162		•
36+63 B BACK	35+25 B	2	162	138	22,356
36+63 B AHD	38+00 B	2	66		
38+00 B BACK	38+00 B	2	66	137	9,042
38+00 B AHD	38+00 B	2	66		•
38+46 B BACK	38+00 B	2	66	46	3,036
38+46 B AHD	38+00 B	1	33		•
39+00 B BACK	38+00 B	1	33	54	1,782
39+00 B AHD	40+00 B	1	40		
40+00 B BACK	40+00 B	1	40	100	4,000
40+00 B AHD	40+00 B	1	40		•
40+54 B	40+00 B	1	40	54	2,160
	•		•	Total:	70,006
				Total (CY):	2,593

- 1. Volume calculated using the Average-End-Area Method along Alignment B with four cross sections and two excavation lines.
- 2. Excavation lines indicate the transition between different depths of excavation.

Excavation Line E at STA 32+60 B

Excavation Line F at STA 38+46 B

- 3. Along Alignment B, assume excavation will extend 5 feet beyond the "Extent of Historical Creek" on each side. The historical creek extent was estimated by Integral Consulting Inc. during the Little Squalicum Park Remedial Investigation based on existing topography, field observations, and historic aerial photos provided by the City of Bellingham and US EPA (Integral 2008).
- 4. Cross-sectional perimeters per AutoCAD (in feet):

33+00 B: 31 35+25 B: 81 38+00 B: 33 40+00 B: 40

5. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

CY = cubic yards

#### References:

Integral Consulting Inc. (Integral). 2008. Little Squalicum Park Remedial Investigation, Bellingham, Washington. Draft Final Report.

Table B10. Alternative 4 - Volume Calculation for Fill and Cap Material for the Middle Reach of the Existing Creek Channel

Station	Cross Section	Cross- Sectional Area to Fill with Excavated Contaminated Material (SF)	Cross-Sectional Area of Excavated Contaminated Material to be Placed Along Upper Reach (SF)	Sectional Area (SF)	Length (ft)	Volume to be Filled with Excavated Contaminated Material (CF)	Volume of Excavated Contaminated Material to be Placed Along Upper Reach (CF)	Volume of Cap Material (CF)
11+00 A	11+50 A	17	202	246				
13+00 A BACK	11+50 A	17	202	246	200	3,400	40,490	49,272
13+00 A AHD	14+50 A	4	202	217				
17+00 A BACK	14+50 A	4	202	217	400	1,600	80,981	86,683
17+00 A AHD	19+50 A	15	202	246				
17+73 A	19+50 A	15	202	246	73	1,095	14,779	17,984
				•	Total:	6,095	136,250	153,940
					Total (CY):	226	5,046	5,701

- 1. Volume calculated using the Average-End-Area Method along Alignment A for the middle reach of the existing creek channel, which starts at STA 11+00 A and ends at STA 17+73 A.
- 2. Along Alignment A, assume full thickness of cap will extend at least 5 feet beyond the surveyed creek extent on each side, and then taper down at a slope of 3H:1V.
- 3. Prior to capping, the upper reach of the existing creek channel will be filled with contaminated material excavated from the upper and lower reaches of the existing creek channel, the area downstream of the box culvert, and the lower reach of the historical creek channel.
- 4. Cross-sectional areas to be filled per AutoCAD (in square feet):

11+50 A: 17 14+50 A: 4 19+50 A: 15

5. Volume of excavated material remaining to be placed along the length of the middle reach above the filled channel:

Volume (in CF): 136,250

6. The remaining excavated contaminated material will be placed along the length of the middle reach above the filled channel with a typical cross section of a rectangle. The base of the middle reach cap/repository area was widened to keep the height below six feet by multiplying the original base length by a factor of 3. The height of the rectangle at each cross section was calculated with the following:

Volume = base x height x length

Upper reach length per AutoCAD (in feet): 673

Base (in feet): 11+50 A: 36 14+50 A: 45 19+50 A: 36

Calculated height (in feet) at: 11+50 A: 5.6

14+50 A: 4.5 19+50 A: 5.6

7. The typical cross section of the cap is assumed to have:

Depth: 2 feet over excavated contaminated material

Side slope: 3H:1V

8. Cross-sectional perimeters for capping (in feet):

11+50 A: 36 14+50 A: 45 19+50 A: 36

9. Cap cross-sectional areas (before subtracting cross-sectional area of excavated contaminated material placed along the middle reach) (in square feet):

11+50 A: 449 14+50 A: 419 19+50 A: 449

#### Abbreviation:

 $\begin{array}{ll} \text{ft} = & \text{feet} \\ \text{SF} = & \text{square feet} \\ \text{CF} = & \text{cubic feet} \\ \text{CY} = & \text{cubic yards} \end{array}$ 

Table B11. Alternative 4 - Volume Calculation for Cap Material for the Upper Reach of the Historical Creek Channel

Station	Cross Section	Cap Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
30+30 B	30+20 B	218		
31+60 B BACK	30+20 B	218	130	28,340
31+60 B AHD	33+00 B	74		
32+15 B BACK	33+00 B	74	55	4,070
32+33 B AHD	33+00 B	74		
32+60 B	33+00 B	74	27	1,998
	•		Total:	34,408
	•		Total (CY):	1,274

- 1. Volume calculated using the Average-End-Area Method along Alignment B starting at STA 30+30 B and ending at STA 32+60 B.
- 2. Along Alignment B, assume full thickness of cap will extend 5 feet beyond the "Extent of Historical Creek" on each side, and then taper down at a slope of 3H:1V.
- 3. The typical cross section of the cap is assumed to have:

Depth: 2 feet Side slope: 3H:1V

4. Cross-sectional perimeters for capping per AutoCAD (in feet):

30+20 B: 103 33+00 B: 31

#### Abbreviation:

ft = feet
SF = square feet
CF = cubic feet
CY = cubic yards

Table B12. Alternative 4 - Volume Calculation for the Excavation of the New Upper Creek Channel (Lower Historical Creek Channel Reoccupied)

Station	Cross Section	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)				
100+00 E	100+50 E	222						
100+75 E BACK	100+50 E	222	75	16,614				
100+75 E AHD	101+00 E	173						
101+75 E BACK	101+00 E	173	100	17,272				
101+75 E AHD	102+00 E	90						
103+00 E	105+50 E	47	125	5,840				
		Total	clean material:	39,726				
		Total clean	material (CY):	1,471				
103+00 E	105+50 E	47						
104+30 E BACK	105+50 E	47	130	6,074				
104+30 E AHD	108+00 E	122						
109+30 E BACK	108+00 E	122	500	61,040				
109+30 E AHD	110+50 E	142						
111+25 E	110+50 E	142	195	27,715				
	94,829							
	To	otal contaminated	material (CY):	3,512				
	134,555							
	Total excavation volume:  Total excavation volume (CY):							

- 1. Volume calculated using the Average-End-Area Method along Alignment E with six cross sections.
- 2. The typical cross section of the new upper creek channel is assumed to be a trapezoid with the following:

Area of Trapezoid = (1/2)(bottom width + top width)(height)

Side slope: 3H:1V Bottom width: 5 feet

Height: (surface elevation) - (calculated bottom elevation)

3. To calculate the new upper creek channel slope:

Upstream surface elevation (historical channel): 33 feet NAVD 1988
Downstream surface elevation (historical channel): 19 feet NAVD 1988
Length of new channel: 1,125 feet therefore:

New channel slope: 0.012

- 4. To determine the height (excavation depth) at each cross section, a profile line (along Alignment E) and a grade line with a 0.012 ft/ft slope were drawn in AutoCAD. The grade line was drawn so that there would be approximately 2 feet or more below the low point of the profile line. The excavation depth at each cross section was calculated as the difference between the surface elevation (profile line) and bottom elevation (grade line).
- 5. Calculated cross section height (in feet):

100+50 E: 7.8 101+00 E: 6.8 102+00 E: 4.7 105+50 E: 3.2 108+00 E: 5.6 110+50 E: 6.1

6. This calculation is for the total excavation volume required to construct the new upper creek channel. Excavation of contaminated soil prior to construction of the new creek channel is taken into account in the summary calculations table (Table B1) in the "Contaminated Material Excavation Volume" column.

#### Abbreviation:

ft = feet

SF = square feet

CF = cubic feet

Table B13. Alternative 5 - Volume Calculation for the Excavation of Contaminated Soil/Sediment from the Upper, Middle and Lower Reaches of the Existing Creek Channel

Station	Cross Section	Depth of Excavation (ft)	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
10+00 A	10+50 A	6	90		
10+50 A BACK	10+50 A	6	90	50	4,500
10+50 A AHD	10+50 A	6	90		
11+00 A	10+50 A	6	90	50	4,500
17+73 A	19+50 A	1	17		
19+50 A BACK	19+50 A	1	17	177	3,009
19+50 A AHD	19+50 A	1	17		
19+55 A	19+50 A	1	17	5	85
24+50 A	24+25 A	2	36		
25+65 A	24+25 A	2	36	115	4,140
				Total:	16,234
				Total (CY):	601

- 1. Volume calculated using the Average-End-Area Method along Alignment A with four cross sections. Calculation includes the upper reach of the existing creek channel (STA 10+00 A to 11+00 A) and the lower reach of the existing creek channel (STA 17+73 A to 25+65 A), excluding the cap/repository area in between.
- 2. The following excavation lines were used for the lower reach of the existing creek channel. Excavation lines indicate the transition between different depths of excavation.

Excavation Line B at STA 19+55 A Excavation Line C at STA 22+00 A Excavation Line D at STA 24+50 A

- 3. Along Alignment A, assume excavation will extend 5 feet beyond the surveyed creek extent on each side.
- 4. Cross-sectional perimeters per AutoCAD (in feet):

10+50 A: 15 19+50 A: 17 22+50 A: 17 24+25 A: 18

5. The excavation will be filled with clean material excavated from the estuary area, as delineated in the City of Bellingham's Little Squalicum Park Preferred Master Plan, October 7, 2009.

#### Abbreviation:

ft = feet SF = square feet CF = cubic feet CY = cubic yards Table B14. Alternative 5 - Volume Calculation for Fill and Cap Material for the Lower

Reach of the Existing Creek Channel

Station	Cross Section	Cross- Sectional Area to Fill (SF)	Cap Cross- Sectional Area (SF)	Length (ft)	Volume of Fill and Cap Material (CF)
19+55 A	22+50 A	15	36		
23+37 A BACK	22+50 A	15	36	382	5,730
23+37 A AHD	24+25 A	12	38		
24+50 A	24+25 A	12	38	113	1,356
				Total:	7,086
				Total (CY):	262

#### **Notes and Assumptions:**

- 1. Volume calculated using the Average-End-Area Method along Alignment A for the lower reach of the existing creek channel, from STA 19+55 A to STA 24+50 A.
- 2. Along Alignment A, assume full thickness of cap will extend 5 feet beyond the surveyed creek extent on each side, and then taper down at a slope of 3H:1V.
- 3. The lower reach of the existing creek channel will be filled with clean backfill and then
- 4. Cross-sectional areas to be filled per AutoCAD (in square feet):

22+50 A: 15 24+25 A: 12

5. The typical cross section of the cap is assumed to have:

Depth: 2 feet over excavated contaminated material

Side slope: 3H:1V

6. Cross-sectional perimeters for capping (after filled) per AutoCAD (in feet):

22+50 A: 12 24+25 A: 13

#### Abbreviation:

 $\begin{array}{ll} \text{ft} = & \text{feet} \\ \text{SF} = & \text{square feet} \\ \text{CF} = & \text{cubic feet} \\ \text{CY} = & \text{cubic yards} \end{array}$ 

Table B15. Alternative 5 - Volume Calculation for Fill and Cap Material for the Middle Reach of the Existing Creek Channel

Station	Cross Section	Cross- Sectional Area to Fill with Excavated Contaminated Material (SF)	Cross-Sectional Area of Excavated Contaminated Material to be Placed Along Upper Reach (SF)	Sectional Area (SF)	Length (ft)	Volume to be Filled with Excavated Contaminated Material (CF)	Volume of Excavated Contaminated Material to be Placed Along Upper Reach (CF)	Volume of Cap Material (CF)
11+00 A	11+50 A	17	315	316				
13+00 A BACK	11+50 A	17	315	316	200	3,400	62,950	63,137
13+00 A AHD	14+50 A	4	315	278				
17+00 A BACK	14+50 A	4	315	278	400	1,600	125,900	111,003
17+00 A AHD	19+50 A	15	315	316				
17+73 A	19+50 A	15	315	316	73	1,095	22,977	23,045
					Total:	6,095	211,827	197,184
		·	·	·	Total (CY):	226	7,845	7,303

- 1. Volume calculated using the Average-End-Area Method along Alignment A for the middle reach of the existing creek channel, which starts at STA 11+00 A and ends at STA 17+73 A.
- 2. Along Alignment A, assume full thickness of cap will extend at least 5 feet beyond the surveyed creek extent on each side, and then taper down at a slope of 3H:1V.
- 3. Prior to capping, the upper reach of the existing creek channel will be filled with contaminated material excavated from the upper and lower reaches of the existing creek channel, the area downstream of the box culvert, and the lower reach of the historical creek channel.
- 4. Cross-sectional areas to be filled per AutoCAD (in square feet):

11+50 A: 17 14+50 A: 4 19+50 A: 15

5. Volume of excavated material remaining to be placed along the length of the middle reach above the filled channel:

Volume (in CF): 211,827

6. The remaining excavated contaminated material will be placed along the length of the middle reach above the filled channel with a typical cross section of a rectangle. The base of the middle reach cap/repository area was widened to keep the height below six feet by multiplying the original base length by a factor of 4. The height of the rectangle at each cross section was calculated with the following:

Volume = base x height x length

Upper reach length per AutoCAD (in feet): 673 Base (in feet): 11+50 A: 48

Base (in feet): 11+50 A: 48 14+50 A: 60 19+50 A: 48

Calculated height (in feet) at: 11+50 A: 6.6 14+50 A: 5.2 19+50 A: 6.6

7. The typical cross section of the cap is assumed to have:

Depth: 2 feet over excavated contaminated material

Side slope: 3H:1V

8. Cross-sectional perimeters for capping (in feet):

11+50 A: 48 14+50 A: 60 19+50 A: 48

9. Cap cross-sectional areas (before subtracting cross-sectional area of excavated contaminated material placed along the middle reach) (in square feet):

11+50 A: 630 14+50 A: 592 19+50 A: 630

#### Abbreviation:

 $\begin{array}{ll} \text{ft} = & \text{feet} \\ \text{SF} = & \text{square feet} \\ \text{CF} = & \text{cubic feet} \\ \text{CY} = & \text{cubic yards} \end{array}$ 

Table B16. Alternative 5 - Volume Calculation for the Excavation of the New Creek Channel (Long Reroute, Lower Historical Creek Channel Reoccupied)

Station	Cross Section	Cross- Sectional Area (SF)	Length (ft)	Volume (CF)
200+00 F	201+50 F	90		
204+50 F BACK	201+50 F	90	450	40,397
204+50 F AHD	210+50 F	173		
211+50 F BACK	210+50 F	173	700	120,904
211+50 F AHD	212+50 F	38		
212+00 F	212+50 F	38	50	1,876
221+50 F	222+50 F	97		
223+00 F BACK	222+50 F	97	150	14,480
223+00 F AHD	225+50 F	9		
227+00 F	225+50 F	9	400	3,652
		Total	clean material:	181,308
		Total clean	material (CY):	6,715
212+00 F	212+50 F	38		
215+00 F BACK	217+50 F	31	300	9,375
215+00 F AHD	217+50 F	31		
220+00 F BACK	222+50 F	97	500	48,265
220+00 F AHD	222+50 F	97		
221+50 F	222+50 F	97	159	15,348
	72,988			
	2,703			
_	254,296			
		Total excavation	volume (CY):	9,418

- 1. Volume calculated using the Average-End-Area Method along Alignment F with six cross sections.
- 2. The typical cross section of the new creek channel is assumed to be a trapezoid with the following:

Area of Trapezoid = (1/2)(bottom width + top width)(height)

Side slope: 3H:1V Bottom width: 5 feet

Height: (surface elevation) - (calculated bottom elevation)

3. To calculate the new creek channel slope:

Upstream surface elevation (historical channel): 33 feet NAVD 1988

Downstream surface elevation (existing channel): 10 feet NAVD 1988

Length of new channel: 2,736 feet therefore:

New channel slope: 0.008

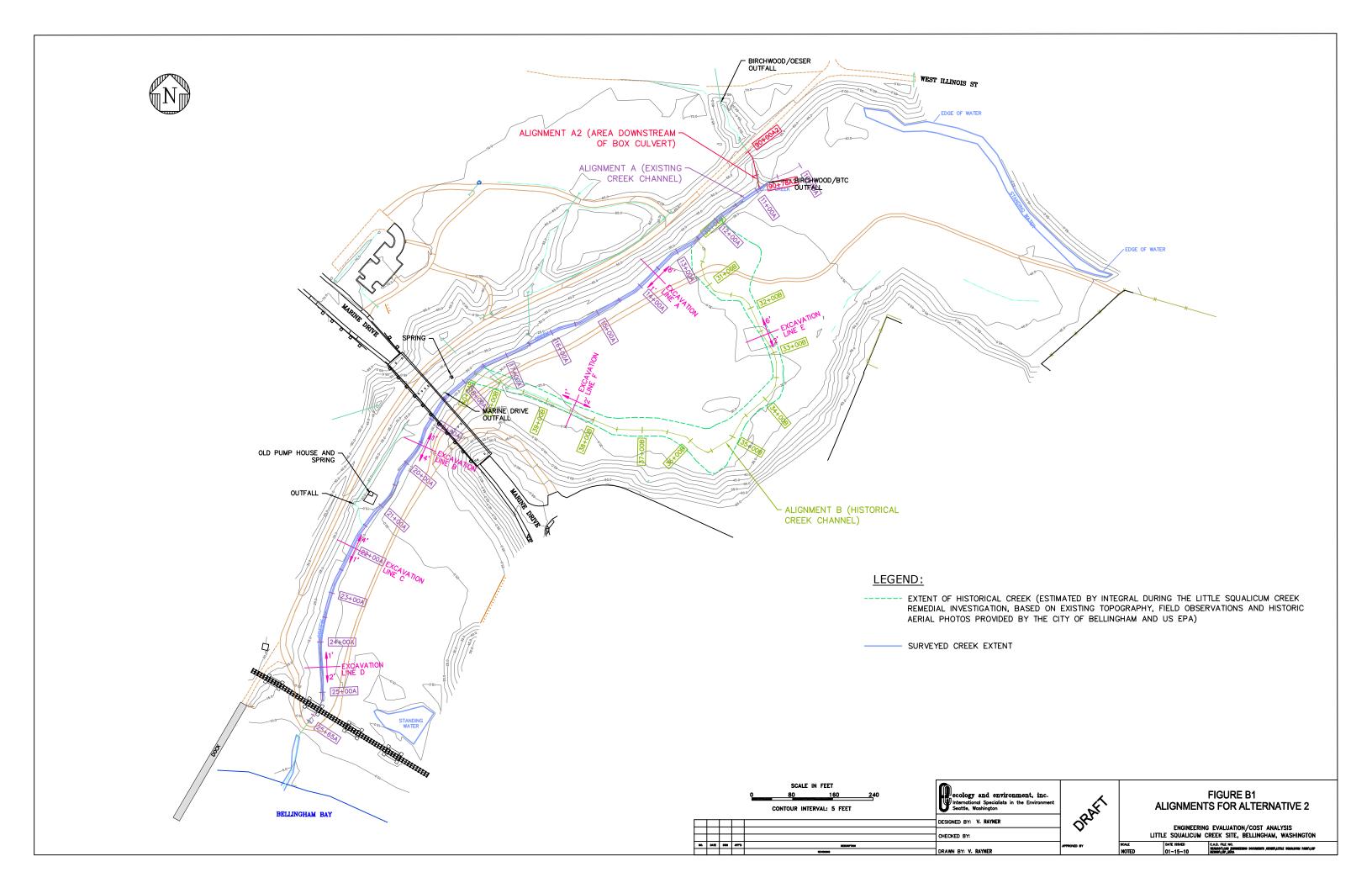
- 4. To determine the height (excavation depth) at each cross section, a profile line (along Alignment F) and a grade line with a 0.008 ft/ft slope were drawn in AutoCAD. The grade line was drawn so that there would be approximately 2 feet or more below the low point of the profile line. The excavation depth at each cross section was calculated as the difference between the surface elevation (profile line) and bottom elevation (grade line).
- 5. Calculated cross section height (in feet):

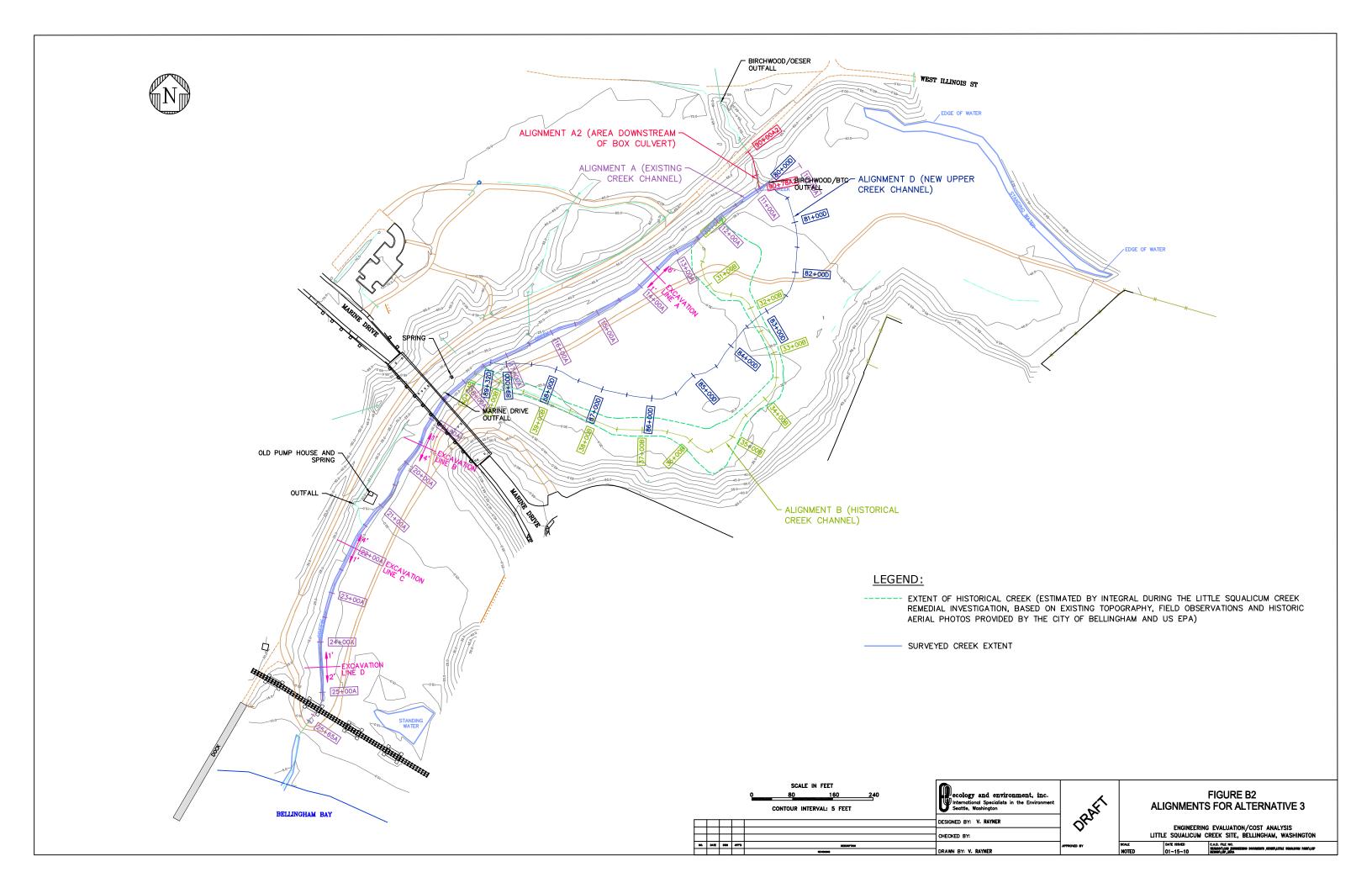
201+50 F: 4.7 210+50 F: 6.8 212+50 F: 2.8 217+50 F: 2.5 222+50 F: 4.9 225+50 F: 1.1

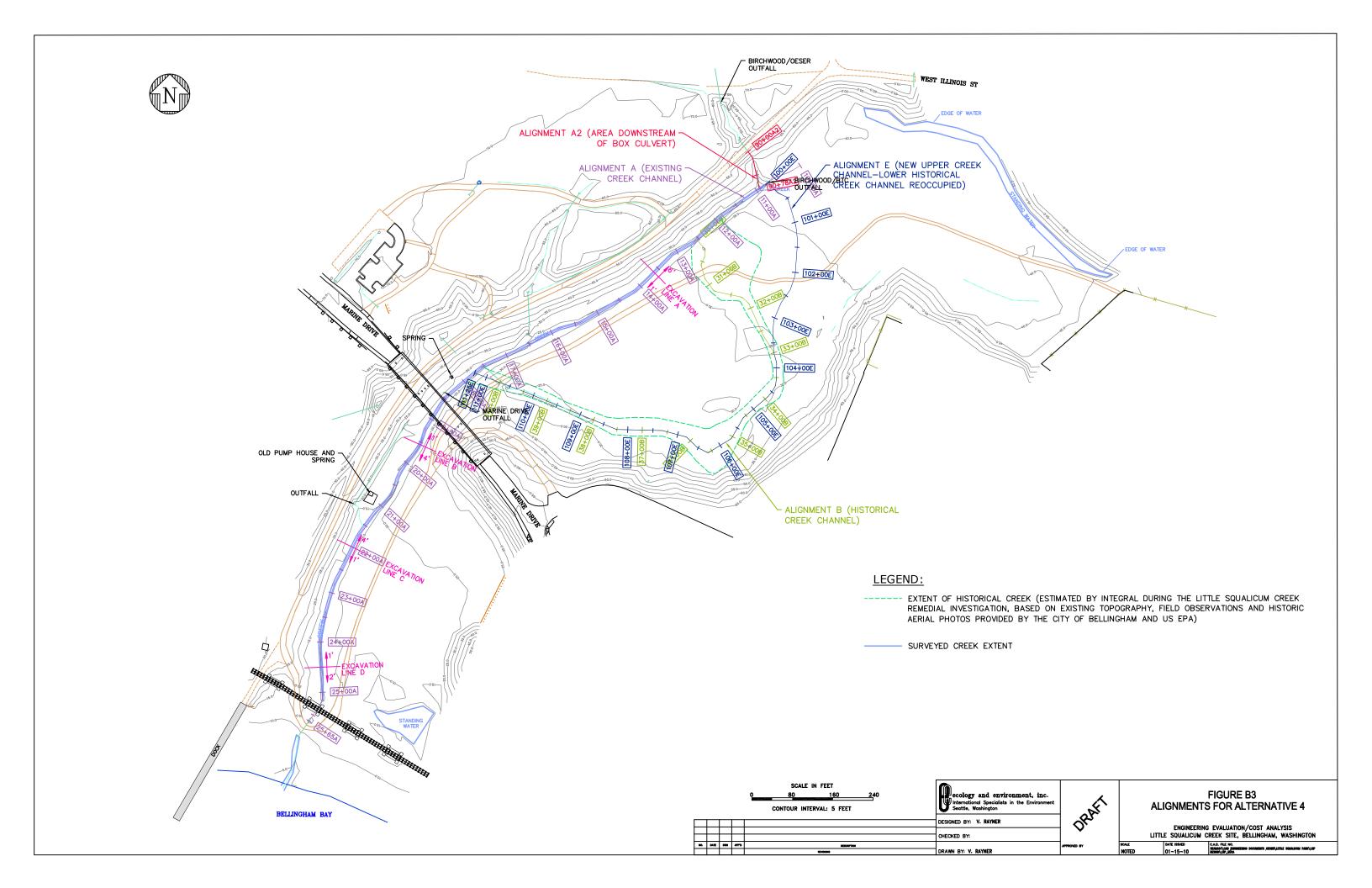
6. This calculation is for the total excavation volume required to construct the new creek channel. Excavation of contaminated soil prior to construction of the new creek channel is taken into account in the summary calculations table (Table B1) in the "Contaminated Material Excavation Volume" column.

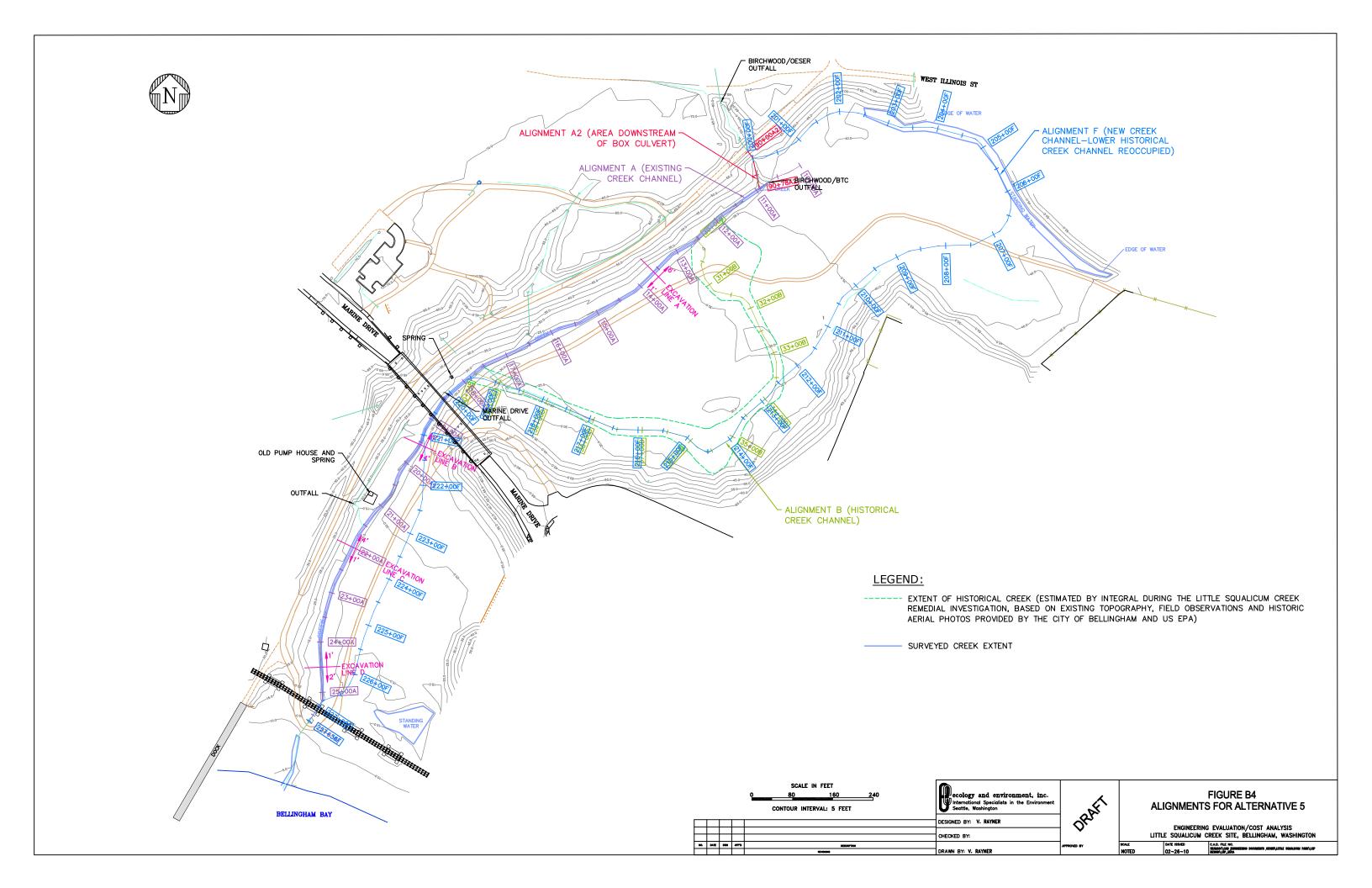
#### Abbreviation:

ft = feet SF = square feet CF = cubic feet











# C Risk Evaluation





## ecology and environment, inc.

International Specialists in the Environment

720 Third Avenue, Suite 1700 Seattle, Washington 98104

Tel: (206) 624-9537, Fax: (206) 621-9832

May 2, 2007

Mary Jane Nearman, EPA Project Manager United States Environmental Protection Agency 1200 6<sup>th</sup> Avenue Seattle, Washington 98101

Re: Review of Little Squalicum Park RI/FS – CERCLA Actionability Evaluation

Dear Ms. Nearman:

Please find attached three technical memoranda prepared by Ecology & Environment, Inc., (E & E) for the purpose of evaluating information provided in the *Draft Report Little Squalicum Park Remedial Investigation/Feasibility Study* (RI/FS) prepared by Integral Consulting Inc. (Integral) on October 27, 2006. As directed by the EPA, E & E reviewed the RI/FS report to evaluate whether newly obtained information regarding contaminants within Little Squalicum Park pose a threat to human health or ecological receptors, and whether action under the Comprehensive Environmental Response Compensation and Liability Act may be warranted.

Please contact me at (206) 624-9537 ext. 3603, or at <u>mlongtine@ene.com</u> if you have any questions regarding this deliverable.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Mark Longtine

E & E Project Manager

Manh Jon

Cc: Don Heyer, CH2M HILL

Carl Mach, E & E

Stephanie Pingree, E & E

Attachments: Technical Memorandum – Conceptual Site Model

Technical Memorandum – Human Health Risk Evaluation Technical Memorandum – Ecological Risk Actionability

## Review of Little Squalicum Park RI/FS Conceptual Site Model

Prepared by Ecology and Environment, Inc. for EPA Region 10

May 2, 2007



## ecology and environment, inc.

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#### TECHNICAL MEMORANDUM

**To:** Mary Jane Nearman, EPA Project Manager **From:** Mark Longtine, Ecology and Environment, Inc.

**Through:** Don Heyer, CH2M HILL

**Date:** May 2, 2007

**Re:** Review of Little Squalicum Park RI/FS – Conceptual Site Model

For the United States Environmental Protection Agency (EPA) Region 10, Ecology & Environment, Inc., (E & E) performed a limited review of the *Draft Report Little Squalicum Park Remedial Investigation/Feasibility Study* (RI/FS) prepared by Integral Consulting Inc. (Integral) on October 27, 2006, for the purpose of evaluating the conceptual site model (CSM) as it pertains to the Oeser Company Site (Oeser). The scope and the results of the CSM review are briefly summarized below.

The 2006 Draft LSP RI/FS CSM discusses source characterization (Section 6.1), fate and transport of chemicals (Section 6.2), and potential receptors and exposure pathways (Section 6.3). Elements of the CSM as it pertains to potential receptors and exposure pathways were reviewed by E & E, as summarized in the accompanying technical memoranda addressing risk to human health and ecological receptors. The source characterization and fate and transport components of the LSP RI/FS CSM were reviewed for the purposes of evaluating whether Oeser could potentially be a source of the some of the contaminants of concern for human health and ecological receptors within the LSP. It should be noted that this review did not endeavor to determine specifically which contaminants observed in the various media within various locations of the LSP are attributable to Oeser, nor did the present review aim to determine whether the selected contaminants could be attributed to other potential sources.

Previous investigations, including the 2002 Oeser Company Site RI (E & E 2002), have documented that polycyclic aromatic hydrocarbon (PAH), pentachlorophenol (PCP), and dioxins/furans are contaminants commonly associated with wood treating operations and disposal practices such as those documented at Oeser. These contaminants have been detected in soil, sediment, surface water, and groundwater samples collected within the LSP, both during the Oeser RI (E & E 2002) and the LSP RI/FS (Integral 2006).

The 2006 LSP RI/FS concludes that a major source of these contaminants of concern within the LSP is stormwater and process wastewater discharged from the Oeser site, including historic discharges from the facility dating to the 1940s. This stormwater/wastewater has been discharged from the Oeser/Birchwood outfall into Little Squalicum Creek. The LSP RI/FS indicates that

subsequent migration of the contaminated stormwater/wastewater, including non-aqueous phase liquid (NAPL), has occurred via surface water and sediment transport within the Little Squalicum Creek, and infiltration into soils and sediments within both the current and historic channels of the creek. Groundwater contamination observed within the LSP is attributed to such infiltration of stormwater/wastewater and subsequent downgradient migration within the LSP.

Based on review of information presented in the 2006 LSP RI/FS report and previous investigations, E & E generally agrees that at least some of the PAH, PCP, and dioxin/furan contamination detected in soil, sediment, groundwater, and surface water within the LSP is likely attributable to Oeser. The LSP RI/FS report also notes the presence of other potential sources of contaminants found in the LSP, including other stormwater outfalls, historic operations at a former gravel pit, a historical landfill, and former railroad tracks.

#### References

Ecology and Environment, Inc., April 2002, *The Oeser Company Superfund Site Remedial Investigation Report*, Bellingham, Washington.

Integral Consulting, Inc., October 27, 2006, Remedial Investigation/Feasibility Study, Little Squalicum Park, Bellingham, WA – Draft Report.

## Review of Little Squalicum Park RI/FS Human Health Risk Evaluation

Prepared by Ecology and Environment, Inc. for EPA Region 10

May 2, 2007



### TECHNICAL MEMORANDUM

**To:** Mary Jane Nearman, EPA Project Manager

**From:** Stephanie Pingree, Ecology and Environment, Inc.

**Through:** Mark Longtine, Ecology and Environment, Inc. and Don Heyer, CH2M HILL

**Date:** May 2, 2007

**Re:** Review of Little Squalicum Park RI/FS – Human Health Risk Evaluation

For the United States Environmental Protection Agency (EPA) Region 10, Ecology & Environment, Inc. (E & E) has reviewed the *Draft Report Little Squalicum Park Remedial Investigation/Feasibility Study* (RI/FS) prepared by Integral Consulting Inc. (Integral) on October 27, 2006 to determine if the current site conditions pose a risk to current and future human receptors at the site. The methodology for review and results are presented in this technical memorandum. Specifically, this review focuses on Sections 6.3.1, 7.1, Appendix D, and Appendix F of the 2006 RI/FS. E & E focused its review on those areas within Little Squalicum Park (LSP) that could potentially be influenced by contamination for the Oeser Superfund Site. For this review, E & E evaluated the following issues:

- Conceptual Site Model;
- Screening for Compounds of Potential Concern;
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

E & E conducted a human health risk assessment (HHRA) at the Oeser Superfund Site, presented as Appendix M in the RI (E & E 2002). The 2002 E & E risk assessment included evaluation of a portion of the LSP that is the subject of the Integral 2006 LSP RI/FS. The conceptual site model and exposure parameters presented in the E & E Oeser HHRA for receptors at the Little Squalicum Creek were used in the current evaluation of the 2006 Integral LSP RI/FS data.

The geographic sub areas evaluated in the E & E Oeser HHRA within the Little Squalicum Creek area include the South Slope, Foot Path, and Soil Spoils Piles. The sub areas evaluated in the Integral LSP RI/FS that may potentially be impacted by the Oeser Superfund Site include the Upper Creek, Lower Creek, Beach, South Slope, General Site, and Historical Creek sub areas. This evaluation focused on these sub areas.

#### **Conceptual Site Model**

Figure 6-1 of the 2006 LSP RI/FS presents the human health conceptual site model (CSM). This CSM is similar to the CSM presented in the 2002 Oeser HHRA with respect to the receptors at Little Squalicum Park. Specifically, the following pathways were determined to be complete

pathways for recreational user/park visitor in both the Integral 2006 LSP CSM and the E & E 2002 Oeser CSM:

- Ingestion and dermal contact with surface soil;
- Inhalation of particulates from surface soil;
- Dermal contact with sediment; and
- Dermal contact with surface water.

Consistent with the E & E 2002 HHRA, these pathways were quantitatively evaluated in this review. In the E & E CSM, inhalation of volatiles from soil was also considered a complete pathway. The Integral 2006 CSM states that soil vapors were not considered a route of exposure because volatile organic compounds (VOCs) were rarely detected in soil. Two VOCs, 2-methylnaphthalene and naphthalene, were considered compounds of concern in subsurface soil in the Integral 2006 LSP RI. If these soils were brought to the surface exposure to vapors from the soil could be a complete pathway. Therefore, E & E included the inhalation of volatiles from soil as a complete pathway for quantitative assessment in this review.

In addition to the exposure pathways listed above, the Integral 2006 LSP CSM also considered the following pathways to be potentially complete:

- Ingestion of (surface) sediment; and
- Ingestion and dermal contact with subsurface soil.

These pathways were eliminated from quantitative evaluation in the E & E 2002 Oeser HHRA. It is not expected that ingestion of sediment by recreational users of the park would be a significant source of exposure. Therefore, this pathway was not quantitatively evaluated in this review. Direct contact (incidental ingestion and dermal contact) with subsurface soil is unlikely at the site unless excavation activities bring subsurface soil to the surface. It was conservatively assumed that contact with subsurface soil (to a maximum depth of 15 feet below ground surface), including ingestion, dermal contact, and inhalation of vapors and particulates, are potentially complete pathway for recreational users in the future. These pathways were added for quantitative evaluation in this review.

Exposure to groundwater (either through ingestion or dermal contact) was assumed to not be a compete pathway of exposure by both Integral (2006) and E & E (2002); therefore, this pathway was not evaluated in this review.

In addition to a recreational user/park visitor, Integral (2006) also identified complete pathways in the CSM for a park worker and a transient. For this evaluation, it is assumed that exposure to a recreational user would be greater than exposure to the other receptors; therefore, the recreational user was the only receptor quantitatively evaluated in this review. This is consistent with the approach taken in the E & E 2002 Oeser HHRA.

# **Screening for Compounds of Potential Concern**

In the Integral 2006 LSP RI/FS, only a screening level evaluation was conducted for human receptors. As such, site concentrations were only compared to screening criteria to determine compounds of potential concern (COPCs). A complete risk assessment, including exposure assessment, toxicity assessment, and risk characterization, was not completed.

For the current review of Integral's selection of COPCs, E & E completed the following steps. The purpose of the review process is ensure that all COPCs are identified by Integral (2006) are carried through quantitative evaluation in this review:

- 1. E & E determined that the screening criteria used by Integral were at least as conservative as criteria accepted by EPA for soils, sediment, and surface water;
- 2. E & E compared maximum detected site concentrations to EPA Region 6 Human Health Medium-Specific Screening Levels (HHSLs); and
- 3. E & E determined if appropriate screening criteria for contaminants in plants and berries were used.

Currently, EPA Region 10's recommended screening process for determining COPCs is to compare site maximum detected concentrations in soils to the Region 6 HHSLs (EPA 2007). Because human exposure to sediments is similar to exposure to soil, maximum detected concentrations in sediments should also be compared to the soil HHSLs. In the Integral LSP RI/FS, Region 9 Preliminary Remediation Goals (PRGs) and Department of Ecology Model Toxics Control Act (MTCA) levels were used to determine COPCs in soil and sediment for human health evaluation.

To determine that the screening criteria used in the Integral 2006 LSP RI/FS were as least as stringent as the Region 6 HHSLs, E & E compared the screening criteria used by Integral to the EPA Region 6 HHSLs for residential soils for the compounds identified as COPCs in either Integral's 2006 LSP RI/FS or E & E's 2002 Oeser HHRA (see Table 1). The following exceptions are noted:

- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans were
  evaluated as groups of compounds in both the Integral 2006 LSP RI/FS and the 2002
  E & E Oeser HHRA. Carcinogenic PAHs and dioxins/furans were identified as
  COPCs in all media and sub areas where data was available except for Beach
  sediments. Carcinogenic PAHs were added as a COPC in surface sediment for the
  Beach sub area for this review. Therefore, evaluation on an individual compound
  basis was not completed.
- Compounds identified as COPCs in the E & E 2002 Oeser HHRA or Integral 2006 LSP RI/FS that do not have available EPA screening or toxicity criteria were not quantitatively evaluated in this review. These compounds include 7-12-dimethylbenz(a)anthracene, 7H-dibenzo(e,g)carbazole, benzo(k)fluoranthene, dibenzo(a,h)pyrene, dibenzo(a,i)pyrene, dibenzo(a,l)pyrene, total extractable petroleum hydrocarbons, total volatile petroleum hydrocarbons, gasoline range hydrocarbons, diesel range hydrocarbons, motor oil, and total petroleum hydrocarbons.
- Inorganic compounds are not expected to be related to contamination from Oeser, and therefore were not evaluated.

For surface water, Integral (2006) compared maximum detected site concentrations to the National Ambient Water Quality Criteria (NAWQC) and the Washington State Department of Ecology MTCA Method B levels. These screening values are appropriate, and the COPCs identified by Integral (2006) were carried through as COPCs for quantitative evaluation in this review.

For all compounds except dioxins, the screening levels used in the Integral 2006 LSP RI/FS were more conservative than the Region 6 HHSLs. For dioxins, the Region 6 HHSL for residential

exposure is less than the value used in the 2006 LSP RI/FS; however, because dioxins were identified as a COPC in all media, this difference in the screening levels did not impact the final list of COPCs. In summary, all organic compounds identified as COPCs in subsurface soil, surface soil, surface sediment, and surface water in the 2006 Integral LSP RI/FS were initially identified as COPCs in this review. In addition, cPAH was added as a COPC in sediments in the Beach sub area.

To further refine the COPC list for the present evaluation, E & E identified the maximum concentration detected for each COPC by sub area and media. These values are show in Table 2. Table 2 also shows EPA Region 6 HHSLs and screening levels used in the 2006 Integral LSP RI/FS. Maximum concentrations above EPA Region 6 HHSLs (at a hazard quotient [HQ] of 1.0 and a cancer risk of 1 x 10<sup>-6</sup>) were carried through this risk evaluation and quantitatively assessed in the risk characterization step. For surface soil, subsurface soil, and sediment, HHSLs for residential soils were used. Because exposure to surface water at this site is similar to (and less than) that for water from a drinking water source, HHSLs for tap water were used for surface water. To provide additional information regarding magnitude of exceedances of screening levels, maximum concentrations above a cancer risk of 10<sup>-4</sup> (high end of the EPA cancer risk range) are bolded and shaded yellow in Table 2. Table 3 provides the final list of COPCs, the maximum site concentrations for all sub areas, and the locations of the maximum concentrations.

To determine if contaminants in berries should be carried through as COPCs for quantitative evaluation, concentrations of contaminants in berries were compared to a calculated screening level using site-specific ingestion rates. The screening levels used in the 2006 Integral LSP RI/FS (Table F-23) were, in general, an order of magnitude below the screening levels used in the 2002 E & E HHRA (Table AD-3). The difference in screening levels can largely be attributed to the difference in berry consumption rates. E & E (2002) used a berry consumption rate provided in EPA's Exposure Factors Handbook (1997a). No reference is provided for the berry consumption rate used by Integral (2006). Only four berry samples (washed and unwashed samples) exceeded the screening level for 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalency (TEQ) derived by E & E (2002). The screening level was consistent with a target cancer risk of 10<sup>-6</sup>. No samples exceeded a screening level at a target cancer risk of 10<sup>-4</sup>. Therefore, consumption of berries was not quantitatively evaluated in this memorandum.

### **Exposure Assessment**

For this evaluation, in order to assess exposure to COPCs in soils, sediment, and surface water, E & E used the exposure parameters and intake equations presented in Tables 4.11 through 4.15 of the 2002 Oeser HHRA. The only exception was evaluation of dermal exposure to contaminants in surface water. For dermal exposure to surface water, E & E used the exposure parameters presented in Table 4.14 of the 2002 Oeser HHRA, but the intake equations provided in *Risk Assessment Guidelines for Superfund (RAGS)*, *Part E* (EPA 2004) because the process for evaluating dermal exposure to contaminants in surface water has been updated since the 2002 HHRA was completed. To calculate the intake (or dermal absorbed dose) for dermal exposure to contaminants in surface water, it was assumed that the event frequency (number of times exposure occurred during a day) was one event per day and the event duration was one hour per event. This assumes a recreational visitor is in contact with surface water for one hour a day during each visit to the site. These values are conservative estimates based on best professional judgment of recreational exposure at the site, and consistent with other exposure parameters used in the 2002 Oeser HHRA.

Maximum detected site concentrations in each media were used as the exposure point concentration (EPC).

# **Toxicity Assessment**

For the present review, E & E updated all toxicity criteria, cancer slope factors (SF) and non-cancer reference doses (RfDs), to ensure that the most recent values were used in this evaluation. Oral RfDs and SFs were used for both oral and dermal routes of exposure. Oral toxicity values were not adjusted for dermal exposure to the site COPCs, consistent with RAGS Part E (EPA 2004). All oral toxicity values were obtained from EPA's Integrated Risk Information System (IRIS), except for cPAHs and dioxins. An inhalation RfD from IRIS was available for naphthalene, only. Therefore, E & E obtained available inhalation toxicity criteria from other sources consistent with EPA's recommended hierarchy (2003). An inhalation SF was available for pentachlorophenol (SF = 0.018 [mg/kg-d]<sup>-1</sup>) from the California EPA (2002). No other inhalation toxicity criteria were available.

The toxicity of cPAHs was assessed as a class of compounds. Various non-bioassay results have been used to determine relative potency factors (RPFs) for the constituent cPAHs. Therefore, the concentration of cPAHs was determined by multiplying the concentration of each individual cPAH constituent by its respective RPF and summing the results for all cPAHs. The SFs for benzo(a)pyrene were used to evaluate the toxicity of cPAHs. The oral SF is available from IRIS and the inhalation SF is available from the National Center of Environmental Assessment (EPA 2007). A value of one-half the detection limit was used as the concentration for each of the nondetected results. Integral (2006) used RPFs available from California Environmental Protection Agency (2005) in their calculation of cPAHs. Integral (2006) included seven of the 25 cPAHs RPFs in the calculation of total cPAHs. The other 18 cPAHs were thus not accounted for. In some instances, this resulted in a significantly lower cPAH concentration than obtained using all the cPAHs. EPA recommends using RPFs from the Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA 1993). To conduct the exposure assessment and risk characterization for this review, E & E recalculated the cPAH concentrations using the EPA values. The cPAH concentration calculated by Integral (2006) and the value calculated by E & E using EPA RPFs are shown in Table 4 for the maximum detected concentration in each sub area.

Individual dioxins and furans are evaluated based on how their toxicity is related to the similar toxic effect of 2,3,7,8- tetrachlorodibenzo-p-dioxin. The relationship between the toxic effects is expressed in terms of a factor, known as the toxicity equivalency factor (TEF). A World Health Organization working group evaluated the TEF values based on existing literature. The WHO TEFs have been recently updated (Vanden Berg et al. 2005). The updated 2005 TEFs were used by Integral (2006) and E & E in this assessment. The assessment of human health risks resulting from exposure to dioxins relies not on individual data for the dioxins and furans, but rather on a value derived using compound-specific concentrations and TEFs. The result is a toxicity value expressed in terms of 2,3,7,8-TCDD TEQ. The TEQ is calculated by multiplying the measured concentration of each dioxin/furan by its assigned TEF and summing all the product values. A value of one-half the detection limit was used as the concentration for each of the non-detected results. The oral SF for 2,3,7,8-TCDD was used to assess the toxicity of the total TEQ. No oral SF is available from IRIS for 2,3,7,8-TCDD; therefore, a value from Health Effects Assessment Summary Tables (HEAST; EPA 1997b) was used in this assessment. This is consistent with the toxicity hierarchy approach specified by EPA (2003).

# **Risk Characterization**

For the present evaluation, cancer risks and non-cancer hazard quotients (HQs) were calculated for recreational receptors potentially exposed to COPCs at the site using the exposure parameters, intake equations, and toxicity criteria described in the previous sections. Initially risks were

calculated based on the maximum detected site concentration. Because recreational receptors would most likely use the full site, the maximum concentration of all sub areas was used. The cancer risks and HQs for each exposure route and media are presented in Tables 5 through 12, and summarized in Table 13. In addition, to assist with the understanding of the contribution to risk by COPCs in each sub area, risks and HQs also were calculated based on the maximum detected site concentration in each sub area. The risks and HQs for the Upper Creek, Lower Creek, Beach, South Slope, General Site, and Historical Site sub areas are presented in Appendix A and summarized in Table 14.

The cancer risk for the site as a whole is  $8 \times 10^{-4}$ , above the EPA threshold of  $10^{-4}$ . The cancer risks are strongly influenced by a surface water sample (collected at location SW-05) from the Upper Creek area, which had a TCDD TEQ cancer risk of  $5.77 \times 10^{-4} \,\mu g/L$ , and from cPAHs in a subsurface soil sample in the Upper Creek/Historical Creek sub area (collected at location SB-11). It should be noted that SB-11 was assigned to two sub areas – both Upper Creek and Historical Creek. Therefore, the risks of exposure to cPAHs from surface and subsurface soil for these sub areas are identical. Noncancer HQs for the site as a whole were below the EPA benchmark of 1.0.

To evaluate these risks further, the 95% upper confidence limit on the mean (UCL) was calculated for subsurface soil using EPA's ProUCL, Version 3.0 software. For subsurface soil, samples found at a depth up to 15 feet below ground surface were included in the 95% UCL calculation. This is the depth to which subsurface soil may be brought to the surface during excavation activities. Duplicate samples (i.e., samples included in both the Upper Creek and Historical Creek sub areas) were deleted to ensure they were not counted twice. The 95% UCL was calculated for the site as a whole based on the assumption that exposure to receptors would be distributed throughout the site. The resulting 95% UCL for cPAHs in subsurface soil for the site is 51.53 mg/kg; the maximum site concentration is 509.66 mg/kg. The resulting cancer risk for exposure to subsurface soil, using the 95% UCL as the EPC for cPAHs in subsurface soil is 1.3 x 10<sup>-5</sup>, below the cancer risk threshold of 10<sup>-4</sup>.

For surface water, 15 samples that were analyzed for dioxins/furans in the sub areas were included in this review. These samples were collected at seven discrete locations in the Upper Creek and Lower Creek sub areas. The maximum site concentration for TCDD TEQ (5.77 x  $10^{-4}$  µg/L) was detected at location SW-05 during the November 1, 2005 sampling event. A subsequent sample collected at the same location on April 27, 2006 showed a concentration of TCDD TEQ of 1.86 x  $10^{-5}$  µg/L, significantly lower than the concentration found in 2005. Although only a small body of data are available, the 95% UCL was calculated for the whole site to provide an estimate of average concentrations at the site. The resulting 95% UCL for surface water is 4.39 x  $10^{-4}$  µg/L. The resulting cancer risk for exposure to surface water, using the 95% UCL as the EPC for TCDD TEQ in surface water is 5.1 x  $10^{-4}$  (TCDD TEQ contribution is 4.2 x  $10^{-4}$ ), above the cancer risk threshold of  $10^{-4}$ .

As mentioned previously, concentrations in surface water at individual sample locations have changed with time. Therefore, E & E also evaluated results for the most recent sampling event at each location. The maximum site concentration for pentachlorophenol, TCDD TEQ, and cPAHs during the most recent sampling event at each location was used to calculate cancer risks. The most recent maximum detected concentrations at each sampling location were 17  $\mu$ g/L for pentachlorophenol at Upper Creek location 320 (1998), 8.86 x 10<sup>-5</sup>  $\mu$ g/L for TCDD TEQ at Upper Creek location SW-04 (1999), and 0.388  $\mu$ g/L for cPAHs at Upper Creek location OS03 (1996; calculated using EPA RPFs). The resulting cancer risk for exposure to surface water is 1.1 x 10<sup>-4</sup>.

Although the maximum detected site concentrations were found in samples taken from 1996, 1998, and 1999 these represent the most recent information for that sampling location.

# **Groundwater Assessment**

E & E compared the maximum detected groundwater concentration in each sub area to the federal maximum contaminant level (MCL). The results are presented in Table 15. Although groundwater is not considered a complete pathway, this comparison provides a reference for which to evaluate groundwater. Multiple metals, PAHs, pentachlorophenol, and TEQ exceed the MCL in one or more sub area. Exceedances of MCLs do not indicate potential risk at this site.

# **Evaluation of Analytical Results Database**

During this review, E & E identified an error with the database provided in Appendix D of the Integral RI. Specifically, incorrect units were used when presenting cPAH data in the LSP Averaged Dataset table for some samples. E & E apprised Integral of the error and, subsequently, Integral provided E & E a revised database. Integral did not provide revised LSP RI/F report text, tables, or figures that were impacted by the database error. The review and risk calculations presented by E & E in this document are based on the revised database.

### **Summary and Conclusions**

E & E evaluated the potential risk or hazard posed to recreational receptors exposed to contaminants in surface soil, subsurface soil, sediment, and surface water at the LSP. Using maximum detected site concentrations, the cancer risk for the site as a whole is 8 x 10<sup>-4</sup>, above the EPA threshold of 10<sup>-4</sup>. The cancer risks are strongly influenced by a single surface water sample (collected at location SW-05) from the Upper Creek area in 2005 and from cPAHs in a subsurface soil sample (collected at location SB-11) in the Upper Creek/Historical Creek sub area. Noncancer HQs were below the EPA benchmark of 1.0.

Further evaluation of site concentrations showed that the cancer risk for exposure to subsurface soil, using the 95% UCL as the EPC for cPAHs is  $1 \times 10^{-5}$ , below the cancer risk threshold of  $10^{-4}$ .

Because contaminant concentrations in surface water at individual sample locations have changed with time, E & E also evaluated risk using the most recent sampling data at each location. The maximum site concentration during the most recent sampling event at each location was used to recalculate cancer risks. The resulting cancer risk for exposure to surface water is 1 x 10<sup>-4</sup>. Therefore, potential risks to recreational receptors at LSP using maximum site concentrations for surface soil and sediment, 95% UCL for subsurface soil, and most recent maximum concentrations in surface water do not exceed the EPA cancer threshold of 10<sup>-4</sup>.

### References

California Environmental Protection Agency, May 2005, Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors, Office of Environmental Health Hazard Assessment.

California Environmental Protection Agency, December 19, 2002, *Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors*, Office of Environmental Health Hazard Assessment.

Ecology and Environment, Inc. (E & E), April 2002, *The Oeser Company Superfund Site Final Human Health Risk Assessment*, Bellingham, Washington.

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United States Environmental Protection Agency (EPA), February 21, 2007, *Region 6 Human Health Medium-Specific Screening Levels* 2007.

United States Environmental Protection Agency (EPA), July 2004, *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) – Final*, Office of Superfund Remediation and Technology Innovation, EPA/540/R/99/005.

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# Review of Little Squalicum Park RI/FS Human Health Risk Evaluation

**TABLES** 

				C	ning Lauri		
				EPA R6 RBC -	ening Levels	3	Most Conservative
Media	Compound	Units	C/NC	Residential	Integral	Integral Source	Screening Level
Surface Soil	Carbazole	mg/kg	С	2.40E+01		R9 PRG DAF1	R9 PRG DAF1
	2,4-Dinitrotoluene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	2,6-Dinitrotoluene	mg/kg	NC	6.10E+01		R9 PRG DAF1	R9 PRG DAF1
	Pentachlorophenol	mg/kg	C/NC	3.00E+00		R9 PRG DAF1	R9 PRG DAF1
	2,4,6-Trichlorophenol	mg/kg	C	4.40E+01		R9 PRG DAF1	R9 PRG DAF1
	Acenaphthene	mg/kg	NC	3.70E+03		R9 PRG DAF1	R9 PRG DAF1
	Fluorene	mg/kg	NC	2.60E+03		R9 PRG DAF1	R9 PRG DAF1
	2-methylnaphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Naphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	cPAHs	mg/kg	С	6.20E-02	4.00L100	NOTINO DALL	TOTAL DATE
	Dioxin TEQ	mg/kg	С	3.90E-06	6 67E-06	MTCA DC	R6 - Residential
	DIOXIII TEQ	ilig/kg	C	3.90E-00	0.07E-00	WITCA DC	No - Nesiderillai
Subsurface Soil	Carbazole	mg/kg	С	2.40E+01	3 00⊏-03	R9 PRG DAF1	R9 PRG DAF1
Jupauriale 3011	2.4-Dinitrotoluene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Pentachlorophenol		C/NC	3.00E+00		R9 PRG DAF1	R9 PRG DAF1
		mg/kg				R9 PRG DAF1	
	2,4,6-Trichlorophenol	mg/kg	C	4.40E+01			R9 PRG DAF1
	Acenaphthene	mg/kg	NC	3.70E+03	2.90E+01	R9 PRG DAF1	R9 PRG DAF1
	Fluoranthene	mg/kg	NC	2.30E+03		R9 PRG DAF1	R9 PRG DAF1
	Fluorene	mg/kg	NC	2.60E+03		R9 PRG DAF1	R9 PRG DAF1
	2-methylnaphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Naphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Pyrene	mg/kg	NC	2.30E+03	2.10E+02	R9 PRG DAF1	R9 PRG DAF1
	cPAHs	mg/kg	С	6.20E-02			
	Dioxin TEQ	mg/kg	С	3.90E-06	6.67E-06	MTCA DC	R6 - Residential
Da alian a mt	Carbanala		С	2.405.04	2.005.02	DO DDC DAE4	DO DDC DAE4
Sediment	Carbazole	mg/kg		2.40E+01		R9 PRG DAF1	R9 PRG DAF1
	n-Nitrosodiphenylamine	mg/kg	C/NC	9.90E+01		R9 PRG DAF1	R9 PRG DAF1
	Pentachlorophenol	mg/kg	C/NC	3.00E+00		R9 PRG DAF1	R9 PRG DAF1
	2,4,6-Trichlorophenol	mg/kg	С	4.40E+01		R9 PRG DAF1	R9 PRG DAF1
	Acenaphthene	mg/kg	NC	3.70E+03	2.90E+01	R9 PRG DAF1	R9 PRG DAF1
	Fluoranthene	mg/kg	NC	2.30E+03		R9 PRG DAF1	R9 PRG DAF1
	Fluorene	mg/kg	NC	2.60E+03		R9 PRG DAF1	R9 PRG DAF1
	2-methylnaphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Naphthalene	mg/kg	NC	1.20E+02		R9 PRG DAF1	R9 PRG DAF1
	Pyrene	mg/kg	NC	2.30E+03	2.10E+02	R9 PRG DAF1	R9 PRG DAF1
	cPAHs	mg/kg	С	6.20E-02			
	Dioxin TEQ	mg/kg	С	3.90E-06	6.67E-06	MTCA DC	R6 - Residential
	5 / 11 1	4	0/10	5.005.04	0.705.04	NAMA 00	NAMA
Surface Water	Pentachlorophenol	ug/L	C/NC	5.60E-01	2.70E-01		NAWQC
	cPAHs	ug/L	С	9.20E-03	3.80E-03		NAWQC
,	Dioxin TEQ	ug/L	С	4.50E-07	გ.64E-09	MTCA METHOD B	MTCA METHOD B
Key:	1	1					
- = Screening lev	vel not available	1					
C = carcinogen	1	1					
	and of Potential Concern						
	genic polychlorinated aroma	atic hydroc	arbons				
mg/kg = milligram							
	el Toxics Control Act Direc						
	nal Ambient Water Quality (	Criteria					
NC = noncarcino							
	= EPA Region 6 Risk Based						
R9 PRG DAF1 =	EPA Region 9 Preliminary	Remediation	on Goal at	a Dilution-Attenuation	n Factor of 1		
	valency to 2,3,7,8-TCDD						
ıg/L = microgram							
NOTES:							
	or benzo(a)pyrene used for						

			-	Table 2. Maxi	mum Detect	ed Concentra	tion by Site S	ubarea				
				Ma	ximum Detec	ted Concentrat	ion			Scre	ening Level	S
Media	Compound	Units	Upper Creek	Lower Creek	Beach	South Slope	General Site	Historical Creek	R6 - HHSL	C/NC	Integral	Integral Source
Surface Soil	Carbazole	mg/kg	4.80E-01	4.46E-01			ND	8.40E-01	2.40E+01	С	3.00E-02	R9 PRG DAF1
Canado Con	2,4-Dinitrotoluene	mg/kg				4.50E-02		0.102 01	1.20E+02	NC	4.00E-05	R9 PRG DAF1
	2,6-Dinitrotoluene	mg/kg				2.20E-02			6.10E+01	NC	3.00E-05	R9 PRG DAF1
	Pentachlorophenol	mg/kg	1.80E+00	5.96E+00			2.20E+00	7.10E+00	3.00E+00	C/NC	1.00E-03	R9 PRG DAF1
	2,4,6-Trichlorophenol	mg/kg	ND	3.20E-02			ND		4.40E+01	С	8.00E-03	R9 PRG DAF1
	Acenaphthene	mg/kg	7.20E+01						3.70E+03	NC	2.90E+01	R9 PRG DAF1
	Fluorene	mg/kg	5.70E+01						2.60E+03	NC	2.80E+01	R9 PRG DAF1
	2-methylnaphthalene	mg/kg	1.10E+01						1.20E+02	NC	4.00E+00	R9 PRG DAF1
	Naphthalene	mg/kg	5.50E+00						1.20E+02	NC	4.00E+00	R9 PRG DAF1
	cPAHs	mg/kg	1.44E+02	3.71E+00		1.94E-01	3.41E+00	1.44E+02	6.20E-02	С		
	TEQ	mg/kg	1.37E-03	1.58E-03		7.81E-05	1.88E-03	1.33E-03	3.90E-06	С	6.67E-06	MTCA DC
		_										
Subsurface Soil	Carbazole	mg/kg	9.30E-01					3.30E+01	2.40E+01	С	3.00E-02	R9 PRG DAF1
	2,4-Dinitrotoluene	mg/kg	ND					4.20E+00	1.20E+02	NC	4.00E-05	R9 PRG DAF1
	Pentachlorophenol	mg/kg	6.40E+00					3.50E+00	3.00E+00	C/NC	1.00E-03	R9 PRG DAF1
	2,4,6-Trichlorophenol	mg/kg	ND 4 control			1		0.005.00	4.40E+01	C	8.00E-03	R9 PRG DAF1
	Acenaphthene	mg/kg	1.60E+02			1		3.20E+02	3.70E+03	NC	2.90E+01	R9 PRG DAF1
	Fluoranthene	mg/kg	1.105:00			1		4.20E+02	2.30E+03	NC	2.10E+02	R9 PRG DAF1
	Fluorene	mg/kg	1.10E+02			1		2.40E+02	2.60E+03	NC	2.80E+01	R9 PRG DAF1 R9 PRG DAF1
	2-methylnaphthalene	mg/kg	1.20E+02					2.80E+02	1.20E+02	NC	4.00E+00	
	Naphthalene	mg/kg	1.60E+02					5.20E+02	1.20E+02	NC	4.00E+00	R9 PRG DAF1
	Pyrene	mg/kg						3.00E+02	2.30E+03	NC	2.10E+02	R9 PRG DAF1
	cPAHs	mg/kg	4.44E+02					4.44E+02	6.20E-02	С	6.67E-06	MTO A DO
	TEQ	mg/kg	4.04E-04					3.59E-04	3.90E-06	С	6.67E-06	MTCA DC
Sediment	Carbazole	mg/kg	2.84E+00	4.78E+00				2.60E-01	2.40E+01	С	3.00E-02	R9 PRG DAF1
Ocamicit	n-Nitrosodiphenylamine	mg/kg	1.95E-01	1.73E-01				2.002 01	9.90E+01	C/NC	6.00E-02	R9 PRG DAF1
	Pentachlorophenol	mg/kg	4.27E+00	4.50E+00	3.90E-02			7.90E+00	3.00E+00	C/NC	1.00E-03	R9 PRG DAF1
	2,4,6-Trichlorophenol	mg/kg	7.40E-01	ND ND	ND			7.30L+00	4.40E+01	C	8.00E-03	R9 PRG DAF1
	Acenaphthene	mg/kg	1.30E+02	IND	ND				3.70E+03	NC	2.90E+01	R9 PRG DAF1
	Fluoranthene	mg/kg	3.40E+02						2.30E+03	NC	2.10E+02	R9 PRG DAF1
	Fluorene	mg/kg	1.00E+02						2.60E+03	NC	2.80E+01	R9 PRG DAF1
	2-methylnaphthalene	mg/kg	8.70E+00						1.20E+02	NC	4.00E+00	R9 PRG DAF1
	Naphthalene	mg/kg	4.30E+00						1.20E+02	NC	4.00E+00	R9 PRG DAF1
	Pyrene	mg/kg	2.20E+02						2.30E+03	NC	2.10E+02	R9 PRG DAF1
	cPAHs	mg/kg	1.43E+01	2.89E+01	9.55E-02			7.94E+01	6.20E-02	C		1101110 27111
	TEQ	mg/kg	7.31E-04	5.93E-03				3.29E-03	3.90E-06	C	6.67E-06	MTCA DC
								0.202				
Surface Water	Pentachlorophenol	ug/L	1.40E+02	1.50E+01					5.60E-01	С	2.70E-01	NAWQC
	cPAHs	ug/L	3.56E-01	3.93E-02	2.30E-01				9.20E-03	С	3.80E-03	NAWQC
	TEQ	ug/L	5.77E-04	5.10E-05					4.50E-07	С	8.64E-09	MTCA METHOD B
Key:												
= Screening lev	rel not available											
C = carcinogen												
	nd of Potential Concern											
	genic polychlorinated aron											
	lealth Medium-Specific So	creening Le	vel (EPA Region	6)								
mg/kg = milligram		L										
	el Toxics Control Act Dire											
	al Ambient Water Quality	Criteria								<u> </u>		
NC = noncarcino		L								<u> </u>		
	EPA Region 9 Preliminary	/ Remediati	on Goal at a Dilu	ation-Attenuatio	n Factor of 1							
	valency to 2,3,7,8-TCDD											
ug/L = microgram	per liter					1						
NOTES:		-				+						
	adad tayt indicates as	um ocass	tration average	Pogion 6 LILIO	for root-land:-!	poile (poile a	andimont\ az t	wotor (ourfor-	water)	-		
	aded text indicates maxim haded text indicates maxi									ovel for an	nooroinocaa	/UO = 1\
	or benzo(a)pyrene used fo		malion exceede	a 100 tilles Ro	- ivesideriiial 0	i rap water lev	er for carcifioger	13 (115K = 10.54)	or ivo screening i	everior no	nicarcinogen	5 (11 cz = 1).
ourserming level to	n penzo(a)pyrene used to	I CEAH.				1			1	1	1	

		Table	3. Maximum Site Co	oncentration	
Media	COPC	Units	Maximum Concentration	Subarea	Location of Maximum
Surface Soil	Pentachlorophenol	mg/kg	7.10E+00	Historical Creek	TP-16
	cPAHs	mg/kg	1.44E+02	Upper Creek/Historical Creek	SB-11
	TEQ	mg/kg	1.88E-03	General Site	SP-07
Subsurface Soil	Carbazole	mg/kg	3.30E+01	Historical Creek	TP-06 @ 1-2 ft bgs
	Pentachlorophenol	mg/kg	6.40E+00	Upper Creek	SB-09 @ 8-9 ft bgs
	2-methylnaphthalene	mg/kg	2.80E+02	Historical Creek	TP-06 @ 1-2ft bgs
	Naphthalene	mg/kg	5.20E+02	Historical Creek	TP-06 @ 1-2ft bgs
	cPAHs	mg/kg	4.44E+02	Upper Creek/Historical Creek	SB-11 @ 1-2 ft bgs
	TEQ	mg/kg	4.04E-04	Upper Creek	SB-11 @ 1-2 ft bgs
Sediment	Pentachlorophenol	mg/kg	7.90E+00	Historical Creek	SB-36
	cPAHs	mg/kg	7.94E+01	Historical Creek	SB-38
	TEQ	mg/kg	5.93E-03	Lower Creek	SB-02
Surface Water	Pentachlorophenol	ug/L	1.40E+02	Upper Creek	SW-05
	cPAHs	ug/L	3.56E-01	Upper Creek	SW-05
	TEQ	ug/L	5.77E-04	Upper Creek	SW-05
Key:					
ft bgs = feet belov	w ground surface				
mg/kg = milligram	ns per kilogram				
ug/L = microgram	n per liter				

Media	Subarea	Units	Max. Conc Integral (1)	Max. Conc E & E (2)	Location of Maximum
Surface Soil	Upper Creek	mg/kg	1.44E+02	1.72E+02	SB-11
	Lower Creek	mg/kg	3.71E+00	3.83E+00	LSC-S1
	South Slope	mg/kg	1.94E-01	3.06E-01	RES-43
	General Site	mg/kg	3.41E+00	3.69E+00	SP07
	Historical Creek	mg/kg	1.44E+02	1.72E+02	SB-11
Subsurface Soil	Upper Creek	mg/kg	4.44E+02	5.10E+02	SB-11 @ 1-2 ft bgs
	Historical Creek	mg/kg	4.44E+02	5.10E+02	SB-11 @ 1-2 ft bgs
Sediment	Upper Creek	mg/kg	1.43E+01	1.50E+01	OS05
	Lower Creek	mg/kg	2.89E+01	2.87E+01	LSC-03
	Beach	mg/kg	9.55E-02	1.69E-01	OS01
	Historical Creek	mg/kg	7.94E+01	8.35E+01	SB-38
Surface Water	Upper Creek	ug/L	3.56E-01	3.93E-01	SW-05 (11/1/2005)
	Lower Creek	ug/L	3.93E-02	4.33E-02	SW-01 (7/26/1999)
	Beach	ug/L	2.30E-01	3.88E-01	OS01 (1/1/1996)
Key:					
	w ground surface				
mg/kg = milligrar					
ug/L = microgran	n per liter				
NOTES:					

CALCULATION OF CANCER RISKS RECRATIONAL USER - SURFACE SOIL Bellingham, Washington Oeser Company Table 5

Scenario Timeframe: Current/Future Medium: Surface Soil

Exposure Medium: Surface Soil Exposure Point: Maximum of all locations Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	04:01	0/10101	ر <del>ا</del> : دا ا	20100 - 00010	Joid Ma
Route	Concern	Value	UTIIIS	кілів Іпіаке	OIIIIS	Slope ractor	RIVI RISK
Dermal	cPAHs	172.08 mg/kg	mg/kg	1.28E-06	1.28E-06 mg/kg-day	7.30E+00	9.33E-06
Dermal	TCDD TEQ	0.00188 mg/kg	mg/kg	3.22E-12	3.22E-12 mg/kg-day	1.50E+05	4.83E-07
Dermal	Pentachlorophenol	7.1	7.1 mg/kg	1.01E-07	1.01E-07 mg/kg-day	1.20E-01	1.22E-08
Subtotal							9.82E-06
Ingestion	cPAHs	172.08 mg/kg	mg/kg	3.92E-06	3.92E-06 mg/kg-day	7.30E+00	2.86E-05
Ingestion	TCDD TEQ	0.00188 mg/kg	mg/kg	4.29E-11	4.29E-11 mg/kg-day	1.50E+05	6.43E-06
Ingestion	Pentachlorophenol	7.1	7.1 mg/kg	1.62E-07	1.62E-07 mg/kg-day	1.20E-01	1.94E-08
Subtotal							3.51E-05
Inhalation	cPAHs	172.08 mg/kg	mg/kg	3.74E-10	3.74E-10 mg/kg-day	3.10E+00	1.16E-09
Inhalation	Dioxin TEQ	0.00188 mg/kg	mg/kg	4.09E-15	4.09E-15 mg/kg-day	1.50E+05	6.14E-10
Inhalation	Pentachlorophenol	7.1	7.1 mg/kg	1.54E-11	1.54E-11 mg/kg-day	1.80E-02	2.78E-13
Subtotal							1.77E-09
Total							4.5E-05

# CALCULATION OF CANCER RISKS RECRATIONAL USER - SUBSURFACE SOIL Oeser Company Table 6

Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Subsurface Soil

Exposure Medium: Subsurface Soil

Exposure Point: Maximum of all locations Receptor Population: Recreational User

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Slope Factor	RM Risk
Dermal	cPAHs	509.66 mg/kg	ng/kg	3.78E-06	3.78E-06 mg/kg-day	7.30E+00	2.76E-05
Dermal	тсрр теа	0.00040 mg/kg	ng/kg	6.92E-13	6.92E-13 mg/kg-day	1.50E+05	1.04E-07
Dermal	Pentachlorophenol	6.4 г	6.4 mg/kg	9.14E-08	9.14E-08 mg/kg-day	1.20E-01	1.10E-08
Dermal	Carbazole	33.0 mg/kg	ng/kg	1.88E-07	1.88E-07 mg/kg-day	2.00E-02	3.77E-09
Subtotal							2.77E-05
Ingestion	cPAHs	509.66 mg/kg	ng/kg	1.16E-05	1.16E-05 mg/kg-day	7.30E+00	8.48E-05
Ingestion	тсрр теа	0.00040 mg/kg	ng/kg	9.21E-12	9.21E-12 mg/kg-day	1.50E+05	1.38E-06
Ingestion	Pentachlorophenol	6.4	6.4 mg/kg	1.46E-07	1.46E-07 mg/kg-day	1.20E-01	1.75E-08
Ingestion	Carbazole	33.0 mg/kg	ng/kg	7.52E-07	7.52E-07 mg/kg-day	2.00E-02	1.50E-08
Subtotal							8.62E-05
Inhalation	cPAHs	509.66 mg/kg	ng/kg	1.11E-09	1.11E-09 mg/kg-day	3.10E+00	3.44E-09
Inhalation	Dioxin TEQ	0.00040 mg/kg	ng/kg	8.79E-16	8.79E-16 mg/kg-day	1.50E+05	1.32E-10
Inhalation	Pentachlorophenol	6.4	6.4 mg/kg	1.39E-11	1.39E-11 mg/kg-day	1.80E-02	2.51E-13
Inhalation	Carbazole	33.0 mg/kg	ng/kg	7.18E-11	7.18E-11 mg/kg-day	1	1
Subtotal							3.57E-09
Total							1.1E-04

CALCULATION OF CANCER RISKS RECRATIONAL USER - SEDIMENT Bellingham, Washington **Oeser Company** Table 7

Exposure Point: Maximum of all locations Scenario Timeframe: Current/Future Exposure Medium: Sediment Medium: Sediment

Receptor Population: Recreational User

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Exposure	Chemical of Potential	Max	oțial	DME Intolo	otici I	Clone Easter	Void Md
Route	Concern	Value		NIVIE IIIIANE		Signe Factor Nivi Nisk	NSIN ININ
Dermal	cPAHs	83.48 mg/kg	mg/kg	5.95E-07	5.95E-07 mg/kg-day	7.30E+00	7.30E+00 4.34E-06
Dermal	TCDD TEQ	0.00593 mg/kg	mg/kg	9.75E-12	9.75E-12 mg/kg-day	1.50E+05	1.46E-06
Dermal	Pentachlorophenol	1.9	7.9 mg/kg	1.08E-07	1.08E-07 mg/kg-day	1.20E-01	1.30E-08
Subtotal							5.82E-06
Total							5.8E-06

# CALCULATION OF CANCER RISKS RECRATIONAL USER - SURFACE WATER Oeser Company

Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Maximum of all locations Receptor Population: Recreational User Receptor Age: Adolescent

HIDE

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	С	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Slope Factor	RME Risk
Dermal	cPAHs	0.39	ug/L	2.74E-06	mg/kg-d	7.00E-01	2.69E+00	1.17E+01	1.00E+00	4.36E+00	1.25E-06	7.30E+00	2.00E-05
Dermal	TCDD TEQ	0.00058	ug/L	3.70E-09	mg/kg-d	8.10E-01	6.82E+00	3.01E+01	5.00E-01	5.65E+00	1.69E-09	1.50E+05	5.55E-04
Dermal	Pentachlorophenol	140.0	ug/L	5.43E-04	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.60E+00	2.48E-04	1.20E-01	6.52E-05
Subtotal													6.40E-04
Total													6.4E-04

# RECRATIONAL USER - SURFACE SOIL NON CANCER CALCULATION OF NON-CANCER HAZARDS Table 9

Bellingham, Washington **Oeser Company** 

Scenario Timeframe: Current/Future

Medium: Surface Soil

Exposure Medium: Surface Soil Exposure Point: Maximum of all locations

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	l Inite	DIME Intake	o+iol I	Reference	C
Route	Concern	Value	SIIIO	NIVIL IIIIANG	OIIIIS	Dose	3
Dermal	Pentachlorophenol	7.1	7.1 mg/kg	6.45E-07	6.45E-07 mg/kg-day	3.00E-02	2.15E-05
Subtotal							2.15E-05
Ingestion	Pentachlorophenol	7.1	7.1 mg/kg	1.03E-06	1.03E-06 mg/kg-day	3.00E-02	3.44E-05
Subtotal							3.44E-05
Inhalation	Pentachlorophenol	7.1	7.1 mg/kg	9.83E-11	9.83E-11 mg/kg-day	1	1
Subtotal							0.00E+00
Total							5.6E-05

# CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER - SUBSURFACE SOIL NON CANCER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil

Exposure Medium: Subsurface Soil Exposure Point: Maximum of all locations

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	Units	RME Intake	Units	Reference	ЙH
Koute	Concern	Value				Dose	
Dermal	Pentachlorophenol	6.4	6.4 mg/kg	5.81E-07	5.81E-07 mg/kg-day	3.00E-02	1.94E-05
Dermal	2-methylnaphthalene	280	280 mg/kg	1.32E-05	1.32E-05 mg/kg-day	4.00E-03	3.31E-03
Dermal	Naphthalene	520	520 mg/kg	2.46E-05	2.46E-05 mg/kg-day	2.00E-02	1.23E-03
Subtotal							4.55E-03
Ingestion	Pentachlorophenol	6.4	6.4 mg/kg	9.30E-07	9.30E-07 mg/kg-day	3.00E-02	3.10E-05
Ingestion	2-methylnaphthalene	280	280 mg/kg	4.07E-05	4.07E-05 mg/kg-day	4.00E-03	1.02E-02
Ingestion	Naphthalene	520	520 mg/kg	7.56E-05	7.56E-05 mg/kg-day	2.00E-02	3.78E-03
Subtotal							1.40E-02
Inhalation	Pentachlorophenol	6.4	6.4 mg/kg	8.86E-11	8.86E-11 mg/kg-day	1	1
Inhalation	2-methylnaphthalene	280	280 mg/kg	1.89E-04	1.89E-04 mg/kg-day	1	1
Inhalation	Naphthalene	520	520 mg/kg	3.52E-04	3.52E-04 mg/kg-day	8.60E-04	4.09E-01
Subtotal							4.09E-01
Total							4E-01

# **RECRATIONAL USER - SEDIMENT NON CANCER** CALCULATION OF NON-CANCER HAZARDS Table 11

Bellingham, Washington **Oeser Company** 

Scenario Timeframe: Current/Future Medium: Sediment

Exposure Medium: Sediment Exposure Point: Maximum of all locations

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	٠ <del>١</del> , ٠٠	0101010		Reference	C
Route	Concern	Value		NIVIE IIIIAKE	OIIIIS	Dose	ğ
Dermal	Pentachlorophenol	7.9	7.9 mg/kg	6.89E-07	6.89E-07 mg/kg-day	3.00E-02	3.00E-02 2.30E-05
Subtotal							2.30E-05
Total							2 3E_05
ıotai					1		Z.3L-03

# CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER - SURFACE WATER NON CANCER

Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Maximum of all locations Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	HQ
Dermal	Pentachlorophenol	140.0	ug/L	3.46E-03	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00	2.48E-04	3.00E-02	1.15E-01
Subtotal													1.15E-01
Total													1.2E-01

# SUMMARY OF RISKS AND HAZARD QUOTIENTS RECRATIONAL USER

Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User

Media	Cancer Risk	Hazard Quotient			
Surface Soil	4.5E-05	5.6E-05			
Subsurface Soil	1.1E-04	4.3E-01			
Sediment	5.8E-06	2.3E-05			
Surface Water	6.4E-04	1.2E-01			
Total Risk/Hazard Index	8.0E-04	5.4E-01			

# SUMMARY OF RISKS AND HAZARD QUOTIENTS ALL SITES/RECRATIONAL USER

Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Exposure Point: Maximum site/subarea concentration

Receptor Population: Recreational User Receptor Age: Adolescent

LOCATION	ALL S	SITES	UPPER	CREEK	LOWER	CREEK	BEA	CH	SOUTH	SLOPE	GENERA	AL SITE	HISTORIC	AL CREEK
Media	Cancer Risk	Hazard Quotient												
Surface Soil	4.5E-05	5.6E-05	4.3E-05	1.4E-05	6.7E-06	4.7E-05			3.5E-07		7.7E-06	1.7E-05	4.3E-05	5.6E-05
Subsurface Soil	1.1E-04	4.3E-01	1.1E-04	1.3E-01									1.1E-04	4.3E-01
Sediment	5.8E-06	2.3E-05	9.7E-07	1.2E-05	3.0E-06	1.3E-05	8.9E-09	1.1E-07					5.2E-06	2.3E-05
Surface Water	6.4E-04	1.2E-01	6.4E-04	1.2E-01	5.8E-05	1.2E-02	1.2E-05							
Total Risk/Hazard Index	8.0E-04	5.4E-01	8.0E-04	2.5E-01	6.8E-05	1.2E-02	1.2E-05	1.1E-07	3.5E-07	0.0E+00	7.7E-06	1.7E-05	1.6E-04	4.3E-01

**Bolded** values indicate risk or hazard above a cancer risk of 10^-4 or a hazard above 1.0.

Location	COPC/IHS	Maximum Concentration	Units	MCL
Upper Creek	Arsenic	25.9	ug/L	10
	Cadmium	1	ug/L	5
	Chromium	121	ug/L	100
	Lead	25	ug/L	15
	Manganese	420	ug/L	50 (1)
	Nickel	221	ug/L	NV
	Bis(2-ethylhexyl)phthalate	32	ug/L	NV
	Carbazole	43	ug/L	NV
	Pentachlorophenol	460	ug/L	1
	Fluoranthene	1400	ug/L	0.2 (2)
	Naphthalene	2800	ug/L	0.2 (2)
	Pyrene	1100	ug/L	0.2 (2)
	cPAHs	215.9	ug/L	0.2 (2)
	TEQ	1.85E-04	ug/L	3.00E-05
Lower Creek	Bis(2-ethylhexyl)phthalate	1.8	ug/L	NV
	cPAHs	0.72	ug/L	0.2 (2)
Historical Creek	Arsenic	3.4	ug/L	10
	Carbazole	43	ug/L	NV
	Pentachlorophenol	16	ug/L	1
	Naphthalene	2800	ug/L	0.2 (2)
	cPAHs	3.674	ug/L	0.2 (2)
	TEQ	8.91E-06	ug/L	3.00E-05
Key:				
	genic polychlorinated aromatic	hydrocarbons.		
	naximum contaminant level.	•		
NV = No value av	vailable.			
TEQ = toxic equiv	valency to 2,3,7,8-TCDD			
ug/L = microgram				
Notes:				
	secondary standard. No MCL	available.		
	penzo(a)pyrene was used for al			
	cates maximum concentration e		401	

#### Review of Little Squalicum Park RI/FS Human Health Risk Evaluation

#### **APPENDIX**

### Table A-1-1 CALCULATION OF CANCER RISKS RECRATIONAL USER Bellingham, Washington Oeser Company

Scenario Timeframe: Current/Future Medium: Surface Soil Exposure Medium: Surface Soil Exposure Point: Upper Creek

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a Os	
Receptor Population: Recreational User	
Zec Yec	Receptor Age: Adolescent
lation	Adole
Hopu	Age:
eptor	eptor
262	Rec

Exposure	Chemical of Potential	Max	Units	RME Intake	Units	Slope Factor	RM Risk
Dormol	1	170 00	2//va	4 20E 0E		7 206 -	90 300 0
ספוושו	CLAUS	172.00 111g/kg	IIIG/KG	1.205-00	.20E-00 111g/kg-day	7.30E+00	3.33E-U0
Dermal	TCDD TEQ	0.00137 mg/kg	mg/kg	2.35E-12	2.35E-12 mg/kg-day	1.50E+05	3.52E-07
Dermal	Pentachlorophenol	1.8	1.8 mg/kg	2.57E-08	2.57E-08 mg/kg-day	1.20E-01	3.08E-09
Subtotal							9.68E-06
Ingestion	cPAHs	172.08 mg/kg	mg/kg	3.92E-06	3.92E-06 mg/kg-day	7.30E+00	2.86E-05
Ingestion	TCDD TEQ	0.00137 mg/kg	mg/kg	3.12E-11	3.12E-11 mg/kg-day	1.50E+05	4.69E-06
Ingestion	Pentachlorophenol	1.8	1.8 mg/kg	4.10E-08	4.10E-08 mg/kg-day	1.20E-01	4.92E-09
Subtotal							3.33E-05
Inhalation	cPAHs	172.08 mg/kg	mg/kg	3.74E-10	3.74E-10 mg/kg-day	3.10E+00	1.16E-09
Inhalation	Dioxin TEQ	0.00137 mg/kg	mg/kg	2.98E-15	2.98E-15 mg/kg-day	1.50E+05	4.47E-10
Inhalation	Pentachlorophenol	1.8	1.8 mg/kg	3.92E-12	3.92E-12 mg/kg-day	1.80E-02	7.05E-14
Subtotal							1.61E-09
Total							4.3E-05

## Table A-1-2 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Upper Creek
Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	o+ial I	DIME Intolo	- dial	Clono Englor	Joid Md
Route	Concern	Value	OIIIIS	NIVIE IIIIANE	OIIIIS	Slope ractor	NIN NISK
Dermal	cPAHs	509.7 mg/kg	ng/kg	3.78E-06	3.78E-06 mg/kg-day	7.30E+00	2.76E-05
Dermal	Dioxin TEQ	0.0004 mg/kg	ng/kg	6.92E-13	6.92E-13 mg/kg-day	1.50E+05	1.04E-07
Dermal	Pentachlorophenol	6.4	6.4 mg/kg	9.14E-08	9.14E-08 mg/kg-day	1.20E-01	1.10E-08
Dermal	Carbazole	0.93	0.93 mg/kg	5.31E-09	5.31E-09 mg/kg-day	2.00E-02	1.06E-10
Subtotal							2.77E-05
Ingestion	cPAHs	509.7 mg/kg	ng/kg	1.16E-05	1.16E-05 mg/kg-day	7.30E+00	8.48E-05
Ingestion	Dioxin TEQ	0.0004 mg/kg	ng/kg	9.21E-12	9.21E-12 mg/kg-day	1.50E+05	1.38E-06
Ingestion	Pentachlorophenol	6.4	6.4 mg/kg	1.46E-07	1.46E-07 mg/kg-day	1.20E-01	1.75E-08
Ingestion	Carbazole	0.93	0.93 mg/kg	2.12E-08	2.12E-08 mg/kg-day	2.00E-02	4.24E-10
Subtotal							8.62E-05
Inhalation	cPAHs	509.7 mg/kg	mg/kg	1.11E-09	1.11E-09 mg/kg-day	3.10E+00	3.44E-09
Inhalation	Dioxin TEQ	0.0004 mg/kg	ng/kg	8.79E-16	8.79E-16 mg/kg-day	1.50E+05	1.32E-10
Inhalation	Pentachlorophenol	6.4	6.4 mg/kg	1.39E-11	1.39E-11 mg/kg-day	1.80E-02	2.51E-13
Inhalation	Carbazole	0.93	0.93 mg/kg	2.02E-12	2.02E-12 mg/kg-day	1	Ī
Subtotal							3.57E-09
Total							1.1E-04

## Table A-1-3 CALCULATION OF CANCER RISKS RECRATIONAL USER Bellingham, Washington Oeser Company

Scenario Timeframe: Current/Future Medium: Sediment

Exposure Medium: Sediment

Exposure Point: Upper Creek

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	o+ial I	010101	0+:«-	20100	70:0
Route	Concern	Value		אווום אפווום וווום אפווום	OFIIES	Units Slope ractor RM RISK	ASIA IVIA
Dermal	CPAHS	15.0 mg/kg	mg/kg	1.07E-07	1.07E-07 mg/kg-day	7.30E+00	7.30E+00 7.81E-07
Dermal	Dioxin TEQ	0.00073 mg/kg	mg/kg	1.20E-12	1.20E-12 mg/kg-day	1.50E+05	1.80E-07
Dermal	Pentachlorophenol	4.27	4.27 mg/kg	5.85E-08	5.85E-08 mg/kg-day	1.20E-01	1.20E-01 7.02E-09
Subtotal							9.68E-07
Toto!							70 75 0
וטומו							3.7 L-07

#### Table A-1-4 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Mediani: Canade Water
Exposure Point: Upper Creek
Receptor Population: Recreational User
Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Slope Factor	RME Risk
Dermal	cPAHs	0.39	ug/L	2.73E-06	mg/kg-d	7.00E-01	2.69E+00	1.17E+01	1.00E+00	4.30E+00	1.25E-06	7.30E+00	2.00E-05
Dermal	TCDD TEQ	0.00058	ug/L	3.70E-09	mg/kg-d	8.10E-01	6.82E+00	3.01E+01	5.00E-01	5.60E+00	1.69E-09	1.50E+05	5.55E-04
Dermal	Pentachlorophenol	140.0	ug/L	5.43E-04	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00	2.48E-04	1.20E-01	6.52E-05
Subtotal													6.40E-04
Total													6.4E-04

### CALCULATION OF NON-CANCER HAZARDS Bellingham, Washington RECRATIONAL USER Oeser Company Table A-1-5

Scenario Timeframe: Current/Future Medium: Surface Soil

Exposure Medium: Surface Soil Exposure Point: Upper Creek Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	o+i ol I	DIME Intole	<u></u>	Reference	C
Route	Concern	Value	CIIIS	NIVIE IIIIANE	OFFICE	Dose	Ŋ
Dermal	Pentachlorophenol	1.8	1.8 mg/kg	1.64E-07	1.64E-07 mg/kg-day	3.00E-02	5.45E-06
Subtotal							5.45E-06
Ingestion	Pentachlorophenol	1.8	1.8 mg/kg	2.62E-07	2.62E-07 mg/kg-day	3.00E-02	8.72E-06
Subtotal							8.72E-06
Inhalation	Pentachlorophenol	1.8	1.8 mg/kg	2.49E-11	2.49E-11 mg/kg-day	1	1
Subtotal							0.00E+00
Total							1.4E-05

# Table A-1-6 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Upper Creek
Receptor Population: Recreational User

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Reference Dose	Я
Dermal	Pentachlorophenol	6.4	6.4 mg/kg	5.81E-07	5.81E-07 mg/kg-day	3.00E-02	1.94E-05
Dermal	2-methylnaphthalene	120	120 mg/kg	5.67E-06	5.67E-06 mg/kg-day	4.00E-03	1.42E-03
Dermal	Naphthalene	160	160 mg/kg	7.56E-06	7.56E-06 mg/kg-day	2.00E-02	3.78E-04
Subtotal							1.81E-03
Ingestion	Pentachlorophenol	6.4	6.4 mg/kg	9.30E-07	9.30E-07 mg/kg-day	3.00E-02	3.10E-05
Ingestion	2-methylnaphthalene	120	120 mg/kg	1.74E-05	1.74E-05 mg/kg-day	4.00E-03	4.36E-03
Ingestion	Naphthalene	160	160 mg/kg	2.33E-05	2.33E-05 mg/kg-day	2.00E-02	1.16E-03
Subtotal							5.56E-03
Inhalation	Pentachlorophenol	6.4	6.4 mg/kg	8.86E-11	8.86E-11 mg/kg-day	I	1
Inhalation	2-methylnaphthalene	120	120 mg/kg	8.11E-05	8.11E-05 mg/kg-day	ł	1
Inhalation	Naphthalene	160	160 mg/kg	1.08E-04	1.08E-04 mg/kg-day	8.60E-04	1.26E-01
Subtotal							1.26E-01
Total							1E-01

### CALCULATION OF NON-CANCER HAZARDS Bellingham, Washington **RECRATIONAL USER** Oeser Company Table A-1-7

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment Exposure Point: Upper Creek Receptor Population: Recreational User Receptor Age: Adolescent

							Ī
Exposure	Chemical of Potential	Max	o+i cl	DIME Intoko	- - -	Reference	C
Route	Concern	Value		NIVIE IIIIANE		Dose	ğ
Dermal	Pentachlorophenol	4.3	4.3 mg/kg	3.72E-07	3.72E-07 mg/kg-day	3.00E-02	3.00E-02 1.24E-05
Subtotal							1.24E-05
Total							1.2E-05

#### Table A-1-8 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Mediani: Canade Water
Exposure Point: Upper Creek
Receptor Population: Recreational User
Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	HQ
Dermal	Pentachlorophenol	140.0	ug/L	3.46E-03	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00	2.48E-04	3.00E-02	1.15E-01
Subtotal													1.15E-01
Total													1.2E-01

#### Table A-1-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS UPPER CREEK, RECRATIONAL USER

Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User

Media	Cancer Risk	Hazard Quotient
Surface Soil	4.3E-05	1.4E-05
Subsurface Soil	1.1E-04	1.3E-01
Sediment	9.7E-07	1.2E-05
Surface Water	6.4E-04	1.2E-01
Total Risk/Hazard Index	8.0E-04	2.5E-01

### CALCULATION OF CANCER RISKS RECRATIONAL USER Bellingham, Washington **Oeser Company** Table A-2-1

Scenario Timeframe: Current/Future Medium: Surface Soil

Exposure Medium: Surface Soil Exposure Point: Lower Creek

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	- -		ر <del>ا</del> : در	0 0 0 0 0	10:01
Route	Concern	Value	Onits	кійе іптаке	Onits	ыоре гастог	KIVI KISK
Dermal	cPAHs	3.83	3.83 mg/kg	2.84E-08	2.84E-08 mg/kg-day	7.30E+00	2.08E-07
Dermal	Dioxin TEQ	0.00158 mg/kg	mg/kg	2.71E-12	2.71E-12 mg/kg-day	1.50E+05	4.06E-07
Dermal	Pentachlorophenol	2.96	5.96 mg/kg	8.51E-08	8.51E-08 mg/kg-day	1.20E-01	1.02E-08
Subtotal							6.24E-07
Ingestion	cPAHs	3.83	3.83 mg/kg	8.73E-08	8.73E-08 mg/kg-day	7.30E+00	6.37E-07
Ingestion	Dioxin TEQ	0.00158 mg/kg	mg/kg	3.60E-11	3.60E-11 mg/kg-day	1.50E+05	5.41E-06
Ingestion	Pentachlorophenol	5.96	5.96 mg/kg	1.36E-07	1.36E-07 mg/kg-day	1.20E-01	1.63E-08
Subtotal							6.06E-06
Inhalation	сРАНѕ	3.83	3.83 mg/kg	8.33E-12	8.33E-12 mg/kg-day	3.10E+00	2.58E-11
Inhalation	Dioxin TEQ	0.00158 mg/kg	mg/kg	3.44E-15	3.44E-15 mg/kg-day	1.50E+05	5.16E-10
Inhalation	Pentachlorophenol	2.96	5.96 mg/kg	1.30E-11	1.30E-11 mg/kg-day	1.80E-02	2.33E-13
Subtotal							5.42E-10
Total							6.7E-06

## Table A-2-2 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil Exposure Medium: Subsurface Soil Exposure Point: Lower Creek Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max Units	RME Intake	Units	Slope Factor	RM Risk
Anna	COLICEILI	value				
Dermal	cPAHs	mg/kg		mg/kg-day	7.30E+00	I
Dermal	Dioxin TEQ	mg/kg	1	mg/kg-day	1.50E+05	1
Dermal	Pentachlorophenol	mg/kg	1	mg/kg-day	1.20E-01	1
Dermal	Carbazole	mg/kg	1	mg/kg-day	2.00E-02	1
Subtotal						0.00E+00
Ingestion	cPAHs	mg/kg	1	mg/kg-day	7.30E+00	1
Ingestion	Dioxin TEQ	mg/kg	1	mg/kg-day	1.50E+05	1
Ingestion	Pentachlorophenol	mg/kg	1	mg/kg-day	1.20E-01	1
Ingestion	Carbazole	mg/kg	1	mg/kg-day	2.00E-02	1
Subtotal						0.00E+00
Inhalation	cPAHs	mg/kg	1	mg/kg-day	3.10E+00	1
Inhalation	Dioxin TEQ	mg/kg	1	mg/kg-day	1.50E+05	1
Inhalation	Pentachlorophenol	mg/kg	-	mg/kg-day	1.80E-02	-
Inhalation	Carbazole	mg/kg	1	mg/kg-day	1	1
Subtotal						0.00E+00
Total						0.0E+00

## Table A-2-3 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment Exposure Point: Lower Creek

Receptor Population: Recreational User

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exposure	Chernical of Potential	Max	اعنون	DME Intole	o i c	Slone Eactor DM Disk	DM Dick
Route	Concern	Value		INVIL IIIIANG	OIIIIS	Olope I actor	NGINI MINI
Dermal	cPAHs	28.7	28.7 mg/kg	2.04E-07	2.04E-07 mg/kg-day		7.30E+00 1.49E-06
Dermal	Dioxin TEQ	0.00593 mg/kg	mg/kg	9.75E-12	9.75E-12 mg/kg-day		.50E+05 1.46E-06
Dermal	Pentachlorophenol	4.50	4.50 mg/kg	6.17E-08	6.17E-08 mg/kg-day	1.20E-01	7.40E-09
Subtotal							2.96E-06
Total							3.0E-06

#### Table A-2-4 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Lower Creek

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Slope Factor	RME Risk
Dermal	cPAHs	0.04	ug/L	3.01E-07	mg/kg-d	7.00E-01	2.69E+00	1.17E+01	1.00E+00	4.30E+00	1.37E-07	7.30E+00	2.20E-06
Dermal	TCDD TEQ	0.00005	ug/L	3.27E-10	mg/kg-d	8.10E-01	6.82E+00	3.01E+01	5.00E-01	5.60E+00	1.49E-10	1.50E+05	4.90E-05
Dermal	Pentachlorophenol	15.0	ug/L	5.82E-05	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00	2.66E-05	1.20E-01	6.99E-06
Subtotal													5.82E-05
Total													5.8E-05

# Table A-2-5 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Soil

Exposure Medium: Surface Soil

Exposure Point: Lower Creek Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	o+ial I	DME Intole	0+ia	Reference	C
Route	Concern	Value	OIIIIS	RIVIE IIIIAKE	OIIIIS	Dose	, i
Dermal	Pentachlorophenol	0.9	6.0 mg/kg	5.42E-07	5.42E-07 mg/kg-day	3.00E-02	1.81E-05
Subtotal							1.81E-05
Ingestion	Pentachlorophenol	0.9	6.0 mg/kg	8.66E-07	8.66E-07 mg/kg-day	3.00E-02	2.89E-05
Subtotal							2.89E-05
Inhalation	Pentachlorophenol	0.9	6.0 mg/kg	8.31E-11	8.31E-11 mg/kg-day	1	1
Subtotal							0.00E+00
Total							4.7E-05

# Table A-2-6 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil

Exposure Medium: Subsurface Soil Exposure Point: Upper Creek

Receptor Population: Recreational User

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Reference Dose	ЙΗ
Dermal	Pentachlorophenol	-	- mg/kg		mg/kg-day	3.00E-02	-
Dermal	2-methylnaphthalene	1	mg/kg	1	mg/kg-day	4.00E-03	1
Dermal	Naphthalene	-	mg/kg		mg/kg-day	2.00E-02	-
Subtotal							0.00E+00
Ingestion	Pentachlorophenol	1	mg/kg	1	mg/kg-day	3.00E-02	1
Ingestion	2-methylnaphthalene	1	mg/kg	1	mg/kg-day	4.00E-03	1
Ingestion	Naphthalene	-	mg/kg		mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Inhalation	Pentachlorophenol	1	mg/kg	1	mg/kg-day	1	1
Inhalation	2-methylnaphthalene	1	mg/kg	1	mg/kg-day	1	1
Inhalation	Naphthalene	-	mg/kg	-	mg/kg-day	8.60E-04	1
Subtotal							0.00E+00
-c+o-L							00+100
Total							

# Table A-2-7 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Sediment

Exposure Medium: Sediment Exposure Point: Lower Creek

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	\(\frac{1}{2}\)	DAME Late	:: :: :-	Reference	C
Route	Concern	Value	OIIIIS	NIVIE IIIIAKE	OFFIES	Dose	Z Z
Dermal	Pentachlorophenol	4.5	4.5 mg/kg	3.93E-07	3.93E-07 mg/kg-day	3.00E-02	1.31E-05
Subtotal							1.31E-05
Total							1.3E-05

### Table A-2-8 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Lower Creek

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	HQ
Dermal	Pentachlorophenol	15.0	ug/L	3.71E-04	mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00	2.66E-05	3.00E-02	1.24E-02
Subtotal													1.24E-02
Total													1.2E-02

### Table A-2-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS LOWER CREEK, RECRATIONAL USER

Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User Receptor Age: Adolescent

Media	Cancer Risk	Hazard Quotient
Surface Soil	6.7E-06	4.7E-05
Subsurface Soil		
Sediment	3.0E-06	1.3E-05
Surface Water	5.8E-05	1.2E-02
Total Risk/Hazard Index	6.8E-05	1.2E-02

### CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER **Oeser Company** Table A-3-1

Scenario Timeframe: Current/Future Exposure Medium: Surface Soil Exposure Point: Lower Creek Medium: Surface Soil

Receptor Population: Recreational User

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. Age:
ceptor
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Value Unit	
_	mg/kg
$\perp$	
E	mg/kg
Ĕ	mg/kg
Ĕ	mg/kg
Ē.	mg/kg
Ë.	mg/kg
Ë.	mg/kg

### CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER Oeser Company Table A-3-2

Scenario Timeframe: Current/Future Exposure Medium: Subsurface Soil Exposure Point: Beach Medium: Subsurface Soil

	Receptor Population: Recreational User Receptor Age: Adolescent	onal User			
					-
Exposure	Chemical of Potential	Max	o+id	DME letake	o+id
Route	Concern	Value	OIIIS	NIVIE IIIIANE	SIIIO
Dermal	cPAHs	-	mg/kg	-	mg/kg-day
Dermal	Dioxin TEQ		mg/kg	1	mg/kg-day
Dermal	Pentachlorophenol	-	mg/kg	1	mg/kg-day
Dermal	Carbazole	-	mg/kg	1	mg/kg-day
Subtotal					
Ingestion	cPAHs	-	mg/kg	-	mg/kg-day
Ingestion	Dioxin TEQ	-	mg/kg	1	mg/kg-day
Ingestion	Pentachlorophenol		mg/kg	1	mg/kg-day
Ingestion	Carbazole		mg/kg	1	mg/kg-day
Subtotal					
Inhalation	cPAHs	-	mg/kg	1	mg/kg-day
Inhalation	Dioxin TEQ	-	mg/kg	•	mg/kg-day
Inhalation	Pentachlorophenol	-	mg/kg	•	mg/kg-day
Inhalation	Carbazole	-	mg/kg	•	mg/kg-day
Subtotal					
F					

Total

0.0E+00

0.00E+00

0.00E+00

2.00E-02

1.20E-01

1.50E+05

1.80E-02

3.10E+00

0.00E+00

7.30E+00 1.50E+05

2.00E-02

1.20E-01

RM Risk

Slope Factor

7.30E+00 1.50E+05

## Table A-3-3 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment Exposure Point: Beach

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	ofice I	DIME Intole	otical I	Olono Footor	Joid Md
Route	Concern	Value	OIIIS	NIVIE IIIIANE		Siope ractor Nivi Nisk	NIN NISK
Dermal	сРАНѕ	0.1692 mg/kg	mg/kg	1.21E-09	1.21E-09 mg/kg-day	7.30E+00	7.30E+00 8.80E-09
Dermal	Dioxin TEQ	-	mg/kg	-	mg/kg-day	1.50E+05	1
Dermal	Pentachlorophenol	0.04	0.04 mg/kg	5.35E-10	5.35E-10 mg/kg-day	1.20E-01	1.20E-01 6.41E-11
Subtotal							8.87E-09
Total							8 9E-09
וסומו							10.0

Table A-3-4
CALCULATION OF CANCER RISKS
RECRATIONAL USER
Oeser Company
Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Surface Water Exposure Medium: Surface Water Exposure Point: Beach Receptor Population: Recreational User Receptor Age: Adolescent

	9	)5	5
RME Risk	1.17E-0	1.17E-05	1.2E-05
DA <sub>event</sub> (mg/cm² - Slope Factor RME Risk event)	7.30E-07 7.30E+00		
DA <sub>event</sub> (mg/cm² - event)			
B (unitless)	1.00E+00 4.30E+00		
FA (unitless) B (unitless)			
t* (hr)	1.17E+01		
τ <sub>event</sub> (hr)	2.69E+00		
Kp (cm/hr)	7.00E-01 2.69E+00		
Units	mg/kg-d		
RME Intake	1.60E-06		
Units	ng/L		
Max Value	0.23 ug/		
Chemical of Potential Concern	cPAHs		
Exposure Route	Dermal	Subtotal	Total

# Table A-3-5 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Soil

Exposure Medium: Surface Soil

Exposure Point: Beach

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	l Inite	OVC+OL TANG	o <del>l</del> io! I	Reference	C
Route	Concern	Value	OIIIIS	NIVIE IIIIANE	OIIIIS	Dose	Ŋ
Dermal	Pentachlorophenol	-	mg/kg	-	mg/kg-day	3.00E-02	-
Subtotal							0.00E+00
Ingestion	Pentachlorophenol	:	mg/kg		mg/kg-day	3.00E-02	-
Subtotal							0.00E+00
Inhalation	Pentachlorophenol	-	mg/kg		mg/kg-day	-	-
Subtotal							0.00E+00
Total							0.0E+00

# Table A-3-6 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil Exposure Medium: Subsurface Soil Exposure Point: Beach

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	را: در ا درا: در ا	010401 1040		Reference	
Route	Concern	Value	OFFICE	NIVIE IIIIAKE	OIIIIS	Dose	Z Z
Dermal	Pentachlorophenol	-	mg/kg	1	mg/kg-day	3.00E-02	1
Dermal	2-methylnaphthalene	ī	mg/kg	ī	mg/kg-day	4.00E-03	I
Dermal	Naphthalene	ī	mg/kg	T	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Ingestion	Pentachlorophenol	1	mg/kg	1	mg/kg-day	3.00E-02	I
Ingestion	2-methylnaphthalene	1	mg/kg	T	mg/kg-day	4.00E-03	I
Ingestion	Naphthalene	T	mg/kg	T	mg/kg-day	2.00E-02	I
Subtotal							0.00E+00
Inhalation	Pentachlorophenol	1	mg/kg	1	mg/kg-day	1	1
Inhalation	2-methylnaphthalene	T	mg/kg	T	mg/kg-day	1	1
Inhalation	Naphthalene	1	mg/kg	1	mg/kg-day	8.60E-04	1
Subtotal							0.00E+00
Total							0E+00

# Table A-3-7 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Point: Beach

Receptor Population: Recreational User

Units Reference HO	Dose	-day 3.00E-02 1.13E-07	1.13E-07	
RME Intake		3.40E-09 mg/kg-day		
Max Units	Value	0.039 mg/kg		
Chemical of Potential	Concern	Pentachlorophenol		
Exposure	Route	Dermal	Subtotal	

Table A-3-8
CALCULATION OF NON-CANCER HAZARDS
RECRATIONAL USER
Oeser Company
Bellingham, Washington

Exposure Medium: Surface Water Exposure Point: Beach Receptor Population: Recreational User Receptor Age: Adolescent Scenario Timeframe: Current/Future Medium: Surface Water

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless) B (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	ğ
Dermal	Pentachlorophenol	-	ng/L	-	mg/kg-d	3.90E-01	mg/kg-d 3.90E-01 3.33E+00 1.38E+01	1.38E+01	9.00E-01	9.00E-01 2.50E+00	-	3.00E-02	-
Subtotal													0.00E+00
Total													0.0E+00

### Table A-3-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS BEACH, RECRATIONAL USER

### Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User Receptor Age: Adolescent

Media	Cancer Risk	Hazard Quotient
Surface Soil		
Subsurface Soil		
Sediment	8.9E-09	1.1E-07
Surface Water	1.2E-05	
Total Risk/Hazard Index	1.2E-05	1.1E-07

### Table A-4-1 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Surface Soil

Exposure Medium: Surface Soil

Exposure Point: South Slope Receptor Population: Recreational User

Chemical of Potential	Max	Units	RME Intake	Units	Slope Factor	RM Risk
Concern	Value					
cPAHs	0.31	0.31 mg/kg	2.28E-09	2.28E-09 mg/kg-day	7.30E+00	1.66E-08
Dioxin TEQ	0.00008 mg/kg	mg/kg	1.34E-13	1.34E-13 mg/kg-day	1.50E+05	2.01E-08
Pentachlorophenol	-	mg/kg	1	mg/kg-day	1.20E-01	1
						3.67E-08
cPAHs	0.31	0.31 mg/kg	60-36E-09	6.99E-09 mg/kg-day	7.30E+00	5.10E-08
Dioxin TEQ	0.00008 mg/kg	mg/kg	1.78E-12	1.78E-12 mg/kg-day	1.50E+05	2.67E-07
Pentachlorophenol		mg/kg	1	mg/kg-day	1.20E-01	1
						3.18E-07
cPAHs	0.31	0.31 mg/kg	6.67E-13	6.67E-13 mg/kg-day	3.10E+00	2.07E-12
Dioxin TEQ	0.00008 mg/kg	mg/kg	1.70E-16	1.70E-16 mg/kg-day	1.50E+05	2.55E-11
Pentachlorophenol	-	mg/kg	1	mg/kg-day	1.80E-02	1
						2.76E-11
						I L
						3.5E-07

## Table A-4-2 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil

Exposure Medium: Subsurface Soil

Exposure Medium: Subsurface Soi Exposure Point: South Slope

Receptor Population: Recreational User

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Slope Factor	RM Risk
Dermal	cPAHs	1	mg/kg	-	mg/kg-day	7.30E+00	1
Dermal	Dioxin TEQ	-	mg/kg	1	mg/kg-day	1.50E+05	-
Dermal	Pentachlorophenol	-	mg/kg	1	mg/kg-day	1.20E-01	-
Dermal	Carbazole	1	mg/kg	1	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Ingestion	сРАНѕ	-	mg/kg	-	mg/kg-day	7.30E+00	-
Ingestion	Dioxin TEQ	1	mg/kg	1	mg/kg-day	1.50E+05	1
Ingestion	Pentachlorophenol	-	mg/kg	1	mg/kg-day	1.20E-01	1
Ingestion	Carbazole	-	mg/kg	-	mg/kg-day	2.00E-02	-
Subtotal							0.00E+00
Inhalation	сРАНѕ	-	mg/kg	-	mg/kg-day	3.10E+00	
Inhalation	Dioxin TEQ	-	mg/kg	1	mg/kg-day	1.50E+05	-
Inhalation	Pentachlorophenol	-	mg/kg	-	mg/kg-day	1.80E-02	1
Inhalation	Carbazole	-	mg/kg	1	mg/kg-day	1	1
Subtotal							0.00E+00
Total							0.0E+00

### CALCULATION OF CANCER RISKS Bellingham, Washington **RECRATIONAL USER Oeser Company** Table A-4-3

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Point: South Slope Exposure Medium: Sediment

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	l Inite	DME Intoke	0+101	Slope Easter DM Disk	Joid Md
Route	Concern	Value	OIIIIS	NIVIE IIIIANE		Slope Factor	NOIN IND
Dermal	cPAHs		mg/kg		mg/kg-day	7.30E+00	-
Dermal	Dioxin TEQ	-	mg/kg	-	mg/kg-day	1.50E+05	1
Dermal	Pentachlorophenol	-	mg/kg	-	mg/kg-day	1.20E-01	1
Subtotal							0.00E+00
Total							0.0E+00

### Table A-4-4 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: South Slope

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Slope Factor	RME Risk
Dermal	cPAHs		ug/L		mg/kg-d	7.00E-01	2.69E+00	1.17E+01	1.00E+00	4.30E+00		7.30E+00	
Dermal	TCDD TEQ		ug/L		mg/kg-d	8.10E-01	6.82E+00	3.01E+01	5.00E-01	5.60E+00		1.50E+05	
Dermal	Pentachlorophenol		ug/L		mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00		1.20E-01	
Subtotal													0.00E+00
Total													0.0E+00

### CALCULATION OF NON-CANCER HAZARDS Bellingham, Washington RECRATIONAL USER Oeser Company Table A-4-5

Medium: Surface Soil Exposure Medium: Surface Soil Exposure Point: South Slope Receptor Population: Recreational User Receptor Age: Adolescent Scenario Timeframe: Current/Future

Chemical of Potential	Max	Units	RME Intake	Units	Reference Dose	Й
	value	"		-	Dose	
	1	mg/kg	1	mg/kg-day	3.00E-02	
						0.00E+00
	1	mg/kg	1	mg/kg-day	3.00E-02	1
						0.00E+00
	7.1	7.1 mg/kg	9.83E-11	9.83E-11 mg/kg-day	-	1
						0.00E+00
						0.0E+00

# Table A-4-6 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil Exposure Medium: Subsurface Soil Exposure Point: South Slope Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	:	- - !	:	Reference	(
Route	Concern	Value	Units	KIME Intake	Units	Dose	ğ
Dermal	Pentachlorophenol	:	- mg/kg	1	mg/kg-day	3.00E-02	
Dermal	2-methylnaphthalene	I	mg/kg	ı	mg/kg-day	4.00E-03	1
Dermal	Naphthalene	1	mg/kg	I	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Ingestion	Pentachlorophenol	1	mg/kg	1	mg/kg-day	3.00E-02	1
Ingestion	2-methylnaphthalene	I	mg/kg	Ī	mg/kg-day	4.00E-03	1
Ingestion	Naphthalene	-	mg/kg	ı	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Inhalation	Pentachlorophenol	1	mg/kg	1	mg/kg-day		1
Inhalation	2-methylnaphthalene	Ī	mg/kg	Ī	mg/kg-day	1	1
Inhalation	Naphthalene	I	mg/kg	Ī	mg/kg-day	8.60E-04	I
Subtotal							0.00E+00
Total							0E+00

# Table A-4-7 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment Exposure Point: South Slope

Exposure Point: South Slope Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	o+i ol I	0101010		Reference	Ol
Route	Concern	Value	OIIIS	NIVIE IIIIAKE	OFFICE	Dose	E S
Dermal	Pentachlorophenol	-	mg/kg		mg/kg-day	3.00E-02	
Subtotal							0.00E+00
Total							0.0E+00

#### Table A-4-8

#### CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company

Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: South Slope

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	HQ
Dermal	Pentachlorophenol		ug/L		mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00		3.00E-02	
Subtotal													0.00E+00
Total													0.0E+00

#### Table A-4-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS SOUTH SLOPE, RECRATIONAL USER

#### Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User

Media	Cancer Risk	Hazard Quotient
Surface Soil	3.5E-07	
Subsurface Soil		
Sediment		
Surface Water		
Total Risk/Hazard Index	3.5E-07	0.0E+00

## Table A-5-1 CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER **Oeser Company**

Scenario Timeframe: Current/Future Medium: Surface Soil

Exposure Medium: Surface Soil Exposure Point: General Site

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	- Inite	DME Intoke	- I	Clopo Eactor	Joid Md
Route	Concern	Value	OIIIIS	NIVIL IIIIANG	OIIIIS	Siope I actor	ACIAI IVIA
Dermal	cPAHs	3.69	3.69 mg/kg	2.74E-08	2.74E-08 mg/kg-day	7.30E+00	2.00E-07
Dermal	Dioxin TEQ	0.00188 mg/kg	mg/kg	3.22E-12	3.22E-12 mg/kg-day	1.50E+05	4.83E-07
Dermal	Pentachlorophenol	2.2	2.2 mg/kg	3.14E-08	3.14E-08 mg/kg-day	1.20E-01	3.77E-09
Subtotal							6.87E-07
Ingestion	cPAHs	3.69	3.69 mg/kg	8.42E-08	8.42E-08 mg/kg-day	7.30E+00	6.15E-07
Ingestion	Dioxin TEQ	0.00188 mg/kg	mg/kg	4.29E-11	4.29E-11 mg/kg-day	1.50E+05	6.43E-06
Ingestion	Pentachlorophenol	2.2	2.2 mg/kg	5.02E-08	5.02E-08 mg/kg-day	1.20E-01	6.02E-09
Subtotal							7.05E-06
Inhalation	сРАНѕ	3.69	3.69 mg/kg	8.04E-12	8.04E-12 mg/kg-day	3.10E+00	2.49E-11
Inhalation	Dioxin TEQ	0.00188 mg/kg	mg/kg	4.09E-15	4.09E-15 mg/kg-day	1.50E+05	6.14E-10
Inhalation	Pentachlorophenol	2.2	2.2 mg/kg	4.79E-12	4.79E-12 mg/kg-day	1.80E-02	8.62E-14
Subtotal							6.39E-10
- -							1 1
lotal							/./E-U0

### CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER Oeser Company Table A-5-2

Scenario Timeframe: Current/Future

Medium: Subsurface Soil Exposure Medium: Subsurface Soil Exposure Point: General Site Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Units	RME Intake	Units	Slope Factor	RM Risk
Dermal	сРАНѕ	mg/kg	ìw	mg/kg-day	7.30E+00	<b>!</b>
Dermal	Dioxin TEQ	mg/kg	- u	mg/kg-day	1.50E+05	1
Dermal	Pentachlorophenol	mg/kg	- m	mg/kg-day	1.20E-01	-
Dermal	Carbazole	mg/kg	i I	mg/kg-day	2.00E-02	1
Subtotal						0.00E+00
Ingestion	cPAHs	mg/kg	i I	mg/kg-day	7.30E+00	1
Ingestion	Dioxin TEQ	mg/kg	<u>ũ</u> -	mg/kg-day	1.50E+05	1
Ingestion	Pentachlorophenol	mg/kg	<u> </u>	mg/kg-day	1.20E-01	-
Ingestion	Carbazole	mg/kg	- -	mg/kg-day	2.00E-02	1
Subtotal						0.00E+00
Inhalation	cPAHs	mg/kg	- m	mg/kg-day	3.10E+00	-
Inhalation	Dioxin TEQ	mg/kg	<u> </u>	mg/kg-day	1.50E+05	1
Inhalation	Pentachlorophenol	mg/kg	<u> </u>	mg/kg-day	1.80E-02	1
Inhalation	Carbazole	mg/kg	<u> </u>	mg/kg-day	1	1
Subtotal						0.00E+00
Total						0.0E+00

### CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER Oeser Company Table A-5-3

Scenario Timeframe: Current/Future

Medium: Sediment Exposure Medium: Sediment Exposure Point: General Site

Receptor Population: Recreational User

Recep

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Exposure	Chemical of Potential	Max	o+i cl	010tal 2110	otical I	Slopo Footor	Joid Md
Route	Concern	Value	SIIIS	RIVIE IIIIAKE	OIIIIS	Siope racioi Nivi Nisk	NIN NISK
Dermal	cPAHs		mg/kg	-	mg/kg-day	7.30E+00	-
Dermal	Dioxin TEQ	-	mg/kg	1	mg/kg-day	1.50E+05	•
Dermal	Pentachlorophenol	1	mg/kg	1	mg/kg-day	1.20E-01	1
Subtotal							0.00E+00
Total							0.0E+00

Table A-5-4
CALCULATION OF CANCER RISKS
RECRATIONAL USER
Oeser Company
Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Surface Water Exposure Medium: Surface Water Exposure Point General Site Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value Units	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless) B (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> -	Slope Factor RME Risk	RME Risk
Dermal	cPAHs	:	ng/L	1	mg/kg-d	7.00E-01	2.69E+00	1.17E+01		4.30E+00		7.30E+00	1
	TCDD TEQ	1	ng/L	1	mg/kg-d				5.00E-01		1	1.50E+05	Ţ
Dermal	Pentachlorophenol	1	ng/L	1	mg/kg-d		3.33E+00				:	1.20E-01	Ţ
Subtotal													0.00E+00
Total													0.0E+00

# Table A-5-5 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Soil Exposure Medium: Surface Soil Exposure Point: General Site

Exposure Point: General Site Receptor Population: Recreational User

1.7E-05							Total
0.00E+00							Subtotal
1	1	3.05E-11 mg/kg-day	3.05E-11	2.2 mg/kg	2.2	Pentachlorophenol	Inhalation
1.07E-05							Subtotal
1.07E-05	3.00E-02	3.20E-07 mg/kg-day	3.20E-07	2.2 mg/kg	2.2	Pentachlorophenol	Ingestion
6.66E-06							Subtotal
6.66E-06	3.00E-02	2.00E-07 mg/kg-day	2.00E-07	2.2 mg/kg	2.2	Pentachlorophenol	Dermal
Z Z	Dose	OIIIIS	NIVIE IIIIAKE	SIIIS	Value	Concern	Route
C	Reference	4:01	DAME INTO	l Inite	Max	Chemical of Potential	Exposure

# Table A-5-6 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Subsurface Soil Exposure Medium: Subsurface Soil

Exposure Medium: Subsurface Soi Exposure Point: General Site

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	Units	RME Intake	Units	Reference	Й
Route	Concern	Value				Dose	
Dermal	Pentachlorophenol	1	- mg/kg	1	mg/kg-day	3.00E-02	1
Dermal	2-methylnaphthalene	1	mg/kg	1	mg/kg-day	4.00E-03	1
Dermal	Naphthalene	ł	mg/kg	1	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Ingestion	Pentachlorophenol	1	mg/kg	-	mg/kg-day	3.00E-02	-
Ingestion	2-methylnaphthalene	ł	mg/kg	1	mg/kg-day	4.00E-03	1
Ingestion	Naphthalene	ŀ	mg/kg	1	mg/kg-day	2.00E-02	1
Subtotal							0.00E+00
Inhalation	Pentachlorophenol	1	mg/kg	-	mg/kg-day	1	-
Inhalation	2-methylnaphthalene	ł	mg/kg	1	mg/kg-day	1	1
Inhalation	Naphthalene	ŀ	mg/kg	1	mg/kg-day	8.60E-04	1
Subtotal							0.00E+00
Total							0E+00

## Table A-5-7 CALCULATION OF NON-CANCER HAZARDS Bellingham, Washington RECRATIONAL USER Oeser Company

Scenario Timeframe: Current/Future

Exposure Medium: Sediment Medium: Sediment

Exposure Point: General Site Receptor Population: Recreational User

0.0E+00							Total
0.00E+00							Subtotal
1	3.00E-02	mg/kg-day	i	mg/kg	1	Pentachlorophenol	Dermal
Ŋ	Dose	OIIIIS	NIVIE IIIIANE	SIIIO	Value	Concern	Route
Ç	Reference	o <del>l</del> ic I	DIME Intoko	- Inite	Max	Chemical of Potential	Exposure

Table A-5-8
CALCULATION OF NON-CANCER HAZARDS
RECRATIONAL USER
Oeser Company
Bellingham, Washington

Scenario Timeframe: Current/Future Medium: Surface Water Exposure Medium: Surface Water Exposure Point: General Site Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value Units	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless) B (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm² - event)	Reference Dose	Й
Dermal	Pentachlorophenol		ng/L		mg/kg-d	mg/kg-d 3.90E-01 3	.33E+00	1.38E+01	1.38E+01 9.00E-01	2.50E+00	-	3.00E-02	-
Subtotal													0.00E+00
Total													0.0E+00

#### Table A-5-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS GENERAL SITE, RECRATIONAL USER

#### Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User Receptor Age: Adolescent

Media	Cancer Risk	Hazard Quotient
Surface Soil	7.7E-06	1.7E-05
Subsurface Soil		
Sediment		
Surface Water		
Total Risk/Hazard Index	7.7E-06	1.7E-05

## Table A-6-1 CALCULATION OF CANCER RISKS Bellingham, Washington RECRATIONAL USER Oeser Company

Scenario Timeframe: Current/Future

Medium: Surface Soil Exposure Medium: Surface Soil Exposure Point: Historical Creek Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	1 loite	DME Intake	oțial I	Slope Factor DM Dick	Joid Md
Route	Concern	Value	OIIIIS	NIVIE IIIIAKE	OIIIIS	Siope racioi	NSIN ININ
Dermal	cPAHs	172	172 mg/kg	1.28E-06	1.28E-06 mg/kg-day	7.30E+00	9.33E-06
Dermal	Dioxin TEQ	0.00133 mg/kg	mg/kg	2.28E-12	2.28E-12 mg/kg-day	1.50E+05	3.42E-07
Dermal	Pentachlorophenol	7.1	7.1 mg/kg	1.01E-07	1.01E-07 mg/kg-day	1.20E-01	1.22E-08
Subtotal							9.68E-06
Ingestion	cPAHs	172	172 mg/kg	3.92E-06	3.92E-06 mg/kg-day	7.30E+00	2.86E-05
Ingestion	Dioxin TEQ	0.00133 mg/kg	mg/kg	3.03E-11	3.03E-11 mg/kg-day	1.50E+05	4.55E-06
Ingestion	Pentachlorophenol	7.1	7.1 mg/kg	1.62E-07	1.62E-07 mg/kg-day	1.20E-01	1.94E-08
Subtotal							3.32E-05
Inhalation	cPAHs	172	172 mg/kg	3.74E-10	3.74E-10 mg/kg-day	3.10E+00	1.16E-09
Inhalation	Dioxin TEQ	0.00133 mg/kg	mg/kg	2.89E-15	2.89E-15 mg/kg-day	1.50E+05	4.34E-10
Inhalation	Pentachlorophenol	7.1	7.1 mg/kg	1.54E-11	1.54E-11 mg/kg-day	1.80E-02	2.78E-13
Subtotal							1.59E-09
Total							4.3E-05

## Table A-6-2 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Subsurface Soil Exposure Medium: Subsurface Soil

Exposure Point: Historical Creek

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max	ران (۱ ا	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- - - -		70:01
Route	Concern	Value	OLIIIS	RIVIE IIIIAKE	OLIIIS	Slope ractor	AINI NISK
Dermal	CPAHS	206.7	509.7 mg/kg	3.78E-06	3.78E-06 mg/kg-day	7.30E+00	2.76E-05
Dermal	Dioxin TEQ	0.0004 mg/kg	mg/kg	6.15E-13	6.15E-13 mg/kg-day	1.50E+05	9.23E-08
Dermal	Pentachlorophenol	3.5	3.5 mg/kg	5.00E-08	5.00E-08 mg/kg-day	1.20E-01	6.00E-09
Dermal	Carbazole	33.0	33.0 mg/kg	1.88E-07	1.88E-07 mg/kg-day	2.00E-02	3.77E-09
Subtotal							2.77E-05
Ingestion	cPAHs	509.7	509.7 mg/kg	1.16E-05	1.16E-05 mg/kg-day	7.30E+00	8.48E-05
Ingestion	Dioxin TEQ	0.0004 mg/kg	mg/kg	9.21E-12	9.21E-12 mg/kg-day	1.50E+05	1.38E-06
Ingestion	Pentachlorophenol	3.5	3.5 mg/kg	7.98E-08	7.98E-08 mg/kg-day	1.20E-01	9.58E-09
Ingestion	Carbazole	33.0	33.0 mg/kg	7.52E-07	7.52E-07 mg/kg-day	2.00E-02	1.50E-08
Subtotal							8.62E-05
Inhalation	cPAHs	509.7	509.7 mg/kg	1.11E-09	1.11E-09 mg/kg-day	3.10E+00	3.44E-09
Inhalation	Dioxin TEQ	0.0004 mg/kg	mg/kg	8.79E-16	8.79E-16 mg/kg-day	1.50E+05	1.32E-10
Inhalation	Pentachlorophenol	3.5	3.5 mg/kg	7.61E-12	7.61E-12 mg/kg-day	1.80E-02	1.37E-13
Inhalation	Carbazole	33.0	33.0 mg/kg	7.18E-11	7.18E-11 mg/kg-day	1	-
Subtotal							3.57E-09
Total							1.1E-04

## Table A-6-3 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment Exposure Point: Historical Creek

Receptor Population: Recreational User

Exposure	Chemical of Potential	Max		PME Inte		20100	70:0 140
Route	Concern	Value	OFFICE	הואום וווומגפ		Office Slope Factor RIVI RISK	ASIN ININ
Dermal	cPAHs	83.48 mg/kg	ng/kg	5.95E-07	mg/kg-day	5.95E-07 mg/kg-day   7.30E+00  4.34E-06	4.34E-06
Dermal	Dioxin TEQ	0.00329 mg/kg	ng/kg	5.41E-12	5.41E-12 mg/kg-day	1.50E+05	8.12E-07
Dermal	Pentachlorophenol	7.90 mg/kg	ng/kg	1.08E-07	1.08E-07 mg/kg-day	1.20E-01	1.30E-08
Subtotal							5.17E-06
Total							5.2E-06

#### Table A-6-4 CALCULATION OF CANCER RISKS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Historical Creek Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Slope Factor	RME Risk
Dermal	cPAHs		ug/L		mg/kg-d	7.00E-01	2.69E+00	1.17E+01	1.00E+00	4.30E+00		7.30E+00	
Dermal	TCDD TEQ		ug/L		mg/kg-d	8.10E-01	6.82E+00	3.01E+01	5.00E-01	5.60E+00		1.50E+05	
Dermal	Pentachlorophenol		ug/L		mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00		1.20E-01	
Subtotal													0.00E+00
Total													0.0E+00

# Table A-6-5 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Soil

Exposure Medium: Surface Soil

Exposure Point: Historical Creek

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure	Chemical of Potential	Max	o+icl I	DIME Intoko	<u>+i-cl</u>	Reference	C
Route	Concern	Value	OIIIIS	NIVIE IIIIANE	OIIIIS	Dose	Ŋ
Dermal	Pentachlorophenol	7.1	7.1 mg/kg	6.45E-07	6.45E-07 mg/kg-day	3.00E-02	2.15E-05
Subtotal							2.15E-05
Ingestion	Pentachlorophenol	7.1	7.1 mg/kg	1.03E-06	1.03E-06 mg/kg-day	3.00E-02	3.44E-05
Subtotal							3.44E-05
Inhalation	Pentachlorophenol	7.1	7.1 mg/kg	9.83E-11	9.83E-11 mg/kg-day		1
Subtotal							0.00E+00
Total							5.6E-05

## CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Bellingham, Washington **Oeser Company** Table A-6-6

Scenario Timeframe: Current/Future Exposure Medium: Subsurface Soil Exposure Point: Historical Creek Medium: Subsurface Soil

Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Reference Dose	НД
Dermal	Pentachlorophenol	3.5	3.5 mg/kg	3.18E-07	3.18E-07 mg/kg-day	3.00E-02	1.06E-05
Dermal	2-methylnaphthalene	280	280 mg/kg	1.32E-05	1.32E-05 mg/kg-day	4.00E-03	3.31E-03
Dermal	Naphthalene	520	520 mg/kg	2.46E-05	2.46E-05 mg/kg-day	2.00E-02	1.23E-03
Subtotal							4.55E-03
Ingestion	Pentachlorophenol	3.5	3.5 mg/kg	5.09E-07	5.09E-07 mg/kg-day	3.00E-02	1.70E-05
Ingestion	2-methylnaphthalene	280	280 mg/kg	4.07E-05	4.07E-05 mg/kg-day	4.00E-03	1.02E-02
Ingestion	Naphthalene	520	520 mg/kg	7.56E-05	7.56E-05 mg/kg-day	2.00E-02	3.78E-03
Subtotal							1.40E-02
Inhalation	Pentachlorophenol	3.5	3.5 mg/kg	4.85E-11	4.85E-11 mg/kg-day	-	-
Inhalation	2-methylnaphthalene	280	280 mg/kg	1.89E-04	1.89E-04 mg/kg-day	1	1
Inhalation	Naphthalene	520	520 mg/kg	3.52E-04	3.52E-04 mg/kg-day	8.60E-04	4.09E-01
Subtotal							4.09E-01
Total							4E-01

## Table A-6-7 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Bellingham, Washington Oeser Company

Scenario Timeframe: Current/Future

Exposure Medium: Sediment Medium: Sediment

Receptor Population: Recreational User Exposure Point: Historical Creek

Exposure	Chemical of Potential	Max	٠ <del>;</del> ٠			Reference	
Route	Concern	Value	OIIIS	NIVIE IIIIAKE	OIIIIS	Dose	ב
Dermal	Pentachlorophenol	6.7	7.9 mg/kg	6.89E-07	6.89E-07 mg/kg-day	3.00E-02	3.00E-02 2.30E-05
Subtotal							2.30E-05
Total							2.3E-05

#### Table A-6-8 CALCULATION OF NON-CANCER HAZARDS RECRATIONAL USER Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water Exposure Point: Historical Creek Receptor Population: Recreational User Receptor Age: Adolescent

Exposure Route	Chemical of Potential Concern	Max Value	Units	RME Intake	Units	Kp (cm/hr)	τ <sub>event</sub> (hr)	t* (hr)	FA (unitless)	B (unitless)	DA <sub>event</sub> (mg/cm <sup>2</sup> - event)	Reference Dose	HQ
Dermal	Pentachlorophenol		ug/L		mg/kg-d	3.90E-01	3.33E+00	1.38E+01	9.00E-01	2.50E+00		3.00E-02	
Subtotal													0.00E+00
Total													0.0E+00

#### Table A-6-9 SUMMARY OF RISKS AND HAZARD QUOTIENTS HISTORICAL CREEK, RECRATIONAL USER

#### Oeser Company Bellingham, Washington

Scenario Timeframe: Current/Future Receptor Population: Recreational User Receptor Age: Adolescent

Media	Cancer Risk	Hazard Quotient
Surface Soil	4.3E-05	5.6E-05
Subsurface Soil	1.1E-04	4.3E-01
Sediment	5.2E-06	2.3E-05
Surface Water		
Total Risk/Hazard Index	1.6E-04	4.3E-01

## Ecological Risk Actionability Technical Memorandum Oeser Company Superfund Site

Prepared by Ecology and Environment, Inc. for EPA Region 10

May 2, 2007

#### **BUFFALO CORPORATE CENTER**

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**To:** Mary Jane Nearman, EPA Project Manager **From:** Carl Mach, Ecology and Environment, Inc.

Through: Mark Longtine, Ecology and Environment, Inc. and Don Heyer, CH2M HILL

**Date:** May 2, 2007

**Re:** Review of Little Squalicum Park RI/FS – Ecological Risk Evaluation

#### 1. Introduction

This technical memorandum evaluates potential ecological risks in Little Squalicum Park (LSP) using data assembled by Integral Consulting, Inc. (Integral) for the Little Squalicum Park Remedial Investigation/Feasibility Study Draft Report (RI/FS, Integral 2006). The LSP RI/FS database includes data for a wide range of chemicals in water, sediment, and soil collected by Integral in 2005 and 2006, by E & E for the Oeser Company RI (E & E 2002), by the Washington Department of Ecology (Ecology) during their 2003 investigation of Little Squalicum Creek (Ecology 2004), and during several previous investigations, as discussed in the draft LSP RI/FS (Integral 2006). For the LSP area, the 2006 LSP RI/FS database is more extensive than the database that was available to E & E for the Oeser Company Site RI and associated ecological risk assessment (ERA, E & E 2002). This memorandum makes use of this larger database to determine if contamination found in LSP can be considered actionable under CERCLA. For this analysis, E & E focused on the chemicals known to be associated with the Oeser Company Site (Oeser) — pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans. As was done in the 2002 Oeser ERA, PAHs were evaluated collectively as total PAHs and dioxins/furans were evaluated collectively as the 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalent (TEQ) concentration.

The remainder of this memorandum is organized as follows:

- Section 2 presents a reassessment of ecological risks to terrestrial ecological receptors, including plants, soil invertebrates, and wildlife;
- Section 3 presents a reassessment of ecological risks to aquatic biota in Little Squalicum Creek; and
- Section 4 provides a summary of the reassessment, presents conclusions regarding actionability under CERCLA, describes the need for additional investigation at the site, and provides a brief evaluation of remediation and risk reduction.

1

#### 2. Terrestrial Ecological Receptors

Soil contamination at the site has the potential to adversely affect three assessment endpoints: (1) plants, (2) soil invertebrates, and (3) wildlife. Potential risks to these assessment endpoints were reassessed using surface and subsurface soil samples (up to 6 feet below ground surface [bgs]) from the 2006 LSP RI/FS database. Samples up to 6 feet bgs were used because plants, soil invertebrates, and/or burrowing mammals may be reasonably expected to contact soil contamination down to this depth. The reassessment used the same screening benchmarks, exposure parameters, and calculation methods as the original Oeser ERA (E & E 2002) so the original and updated results would be comparable.

#### 2.1 Plants and Soil Fauna

Potential risks to plants and soil fauna were evaluated by comparing concentrations of PCP, total PAHs, and dioxins/furans in soil to benchmarks for the protection of plants and soil fauna. No benchmarks were exceeded in samples collected on the south slope (see Table 1).

In the Little Squalicum Creek (LSC) ravine, the PCP phytotoxicity benchmark was exceeded at three locations and the PCP earthworm benchmark was exceeded at one location (see Table 1). The exceedances occurred in soil samples collected from the historic and lower creek areas (see Table 2). In general, the magnitude of the exceedances was not great (see Table 2).

For total PAHs, the benchmarks for phytotoxicity and earthworms were exceeded at ten and nine locations, respectively, in the LSC ravine (see Table 1). Nearly all of the exceedances occurred in the historic and upper creek areas (see Table 3). In eight samples, the benchmarks were exceeded by a factor of ten or more (see Table 3).

#### 2.2 Wildlife

In the 2002 Oeser ERA, two wildlife receptors with a high potential for exposure to soil contamination, the American robin (*Turdus migratorius*) and masked shrew (*Sorex cinereus*), were evaluated. The exposure point concentrations, exposure estimates, and hazard quotients for these two receptors were recalculated using the 2006 LSP RI/FS database. Tables 2 through 5 list the soil samples and concentration data that were used. Table 6 compares the original and updated exposure point concentrations, exposure estimates, and hazard quotients. The results are discussed below by chemical group.

#### 2.2.1 Pentachlorophenol

For PCP, the results of the wildlife assessment for the 2002 Oeser ERA change little when the 2006 LSP RI/FS database is used in the analysis. There is an 80% increase in the exposure point concentrations for surface soil and prey (i.e., earthworms) and a

similar increase in the exposure estimates and hazard quotients for the shrew (see Table 6). However, as in the 2002 Oeser ERA, the lowest observed adverse effects level (LOAEL)-based hazard quotient for the shrew is much less than 1, suggesting that risks to insectivorous mammals from PCP in soil are negligible. Risks to other groups of mammals from PCP are also likely to be negligible given that their exposure to PCP through the food chain would be lower than for the shrew. No avian toxicity reference value for PCP is available; hence, risks cannot be calculated for the robin (see Table 6).

#### 2.2.2 Total PAHs

For total PAHs, the exposure estimates and hazard quotients for the robin and shrew are greater for the 2006 LSP RI data than the 2002 Oeser ERA data by a factor of five. For the robin, this increase has little effect on the conclusions of the assessment because the LOAEL-based hazard quotient is still less than 1.0 (see Table 6). However, for the shrew, the LOAEL-based hazard quotient increases from 3.4 to 15.8 using the 2006 LSP RI/FS data (see Table 6). This result suggests that insectivorous mammals in the ravine may be affected by PAH contamination in soil.

It should be noted that the LOAEL-based hazard quotient for the shrew for total PAHs also was greater than 1 in the 2002 Oeser ERA (see Table 6). In the conclusions of the 2002 Oeser ERA, it was argued that although the critical value of 1 was exceeded for the shrew, an adverse impact to the local shrew population was unlikely for several reasons: (1) only one hotspot of soil contamination was identified in 1999; (2) the total PAH concentration in earthworms, the assumed prey of the shrew, was conservatively modeled, not measured; and (3) besides earthworms, shrews consume other foods (e.g., grasshoppers and other insects) that are less likely to accumulate PAHs from soil. This argument is no longer supportable given that a more extensive area of PAH contamination in soil has been identified in the historic and upper creek areas and the LOAEL-based hazard quotient for the shrew is 15.8 for total PAHs.

#### 2.2.3 Dioxins/furans

For dioxins/furans, the exposure estimates and hazard quotients for the robin and shrew increase by a factor of two using the 2006 LSP RI/FS data. For the robin, this increase results in a LOAEL-based hazard quotient of 1 (see Table 6), suggesting that a threshold for adverse effects has been reached. For the shrew, the LOAEL-based hazard quotient increases to 14.4 (see Table 6). This result suggests that insectivorous mammals in the ravine may be affected by dioxin/furan contamination in soil.

As noted above for total PAHs, the LOAEL-based hazard quotient for the shrew for dioxins/furans also exceeded 1 in the 2002 Oeser ERA. However, for the same reasons given above for total PAHs, a population level risk from dioxins/furans was considered unlikely. This position is no longer supportable given that additional contamination hotspots have been identified and the LOAEL-based hazard quotient is 14.4 for dioxins/furans.

#### 3. Aquatic Biota in Little Squalicum Creek

Both Ecology and Integral have investigated Little Squalicum Creek since the 2002 Oeser RI was completed. Ecology (2004) presents results from a sediment investigation conducted in September 2003. Integral (2005) provides results for surface water samples collected in November 2005. Both studies found greater levels of contamination than were found in 1999 for the 2002 Oeser RI.

#### 3.1 Surface Water

For the 2002 Oeser RI, surface water was collected from six locations in the creek, a seep, and a tapped spring. Each station was sampled in July and December 1999. In July 1999, no chemicals in surface water exceeded water quality criteria or benchmarks. In December 1999, the PCP concentration in a single sample marginally exceeded the PCP chronic water quality criterion. Overall, the 1999 data suggested that levels of site-related chemicals in surface water did not pose a threat to aquatic life in the creek; therefore, no remedial action was deemed necessary at that time.

In November 2005, Integral collected surface water from two creek locations. The PCP concentration in both samples (13 and 15  $\mu$ g/L) exceeded the acute national ambient water quality criterion (NAWQC) for PCP (2.5  $\mu$ g/L at pH 5.74). PAHs were not detected in the samples and dioxins/furans were not analyzed. Integral also sampled storm-sewer flows in November 2005. A sample collected at the Oeser/Birchwood outfall contained 140  $\mu$ g/L PCP. This concentration greatly exceeds the acute water quality criterion for PCP. No PCP was detected in a sample of Birchwood neighborhood stormwater collected upstream from the Oeser Company property. These data suggest that PCP is being released to the creek from the Oeser Company property and resulting in concentrations in creek surface water that may be toxic to aquatic life.

#### 3.2 Sediment

For sediment, a weight-of-evidence approach typically is used to determine if an ecological risk is present that may require sediment remediation. The approach begins by comparing sediment chemical concentrations with benchmarks and, if benchmarks are exceeded, continues with sediment bioassays and/or field surveys of the benthic community. Sediment bioassays and benthic surveys provide a site-specific measure of toxicity (or the lack thereof) and thus carry more weight than benchmark comparisons when making decisions about the need for sediment remediation. Hence, this section focuses on the available sediment bioassay data for the creek.

The most current bioassay data that can be used to evaluate ecological impacts from sediment contamination in the Little Squalicum Creek are from Ecology (2004). In September 2003, Ecology conducted toxicity tests with sediment from five creek locations. Three tests (10-day amphipod, 20-day midge, and Microtox) were conducted with sediment from each location. At two of their sampling locations (LCS02 and LSC03, located midway between the Marine Drive Bridge and Bellingham Bay) midge

and/or amphipod survival was depressed by 25% or more compared with laboratory controls. Lesser effects were observed at other locations.

In 1999 for the Oeser Company Site RI, no adverse effects on survival or growth were observed in a 10-day amphipod test conducted with sediment from ten locations in the creek. The difference between the 1999 and 2003 results is most likely due to greater levels of sediment contamination in 2003 compared with 1999. For example, at one location, Ecology found 430 mg/kg total PAHs in sediment, a concentration 50 times greater than anything encountered in 1999. In addition, naphthalene levels in sediment throughout the creek in 2003 were much greater than in 1999. Because naphthalene is the least persistent PAH, the 2003 data suggest that there are ongoing sources of naphthalene and other PAHs to the creek. Because the creek is used as an extension of the storm sewer system, it seems likely that new contamination from various potential sources, including Oeser (see Section 3.1), may enter the creek from time to time.

#### 4. Summary and Conclusions

Using the LSP RI/FS database, risks to terrestrial and aquatic ecological receptors in LSP were reassessed. Key results are described below.

- Plants and Soil Invertebrates -- Risks to plants and soil invertebrates are primarily driven by total PAHs in soil in the historic and upper creek areas. Total PAH levels in soil exceed the screening benchmarks for plants and soil invertebrates by an order-of-magnitude or more at locations TP-6, TP-16, TP-17, SB-11, SB-12, and SP02.
- Wildlife -- Insectivorous mammals (e.g., shrew) using the LSC ravine may be impacted by total PAHs in soil in the historic and upper creek areas and by dioxins/furans in soil in the historic, upper, and lower creek areas; the LOAEL-based hazard quotients for the masked shrew were 15.8 for total PAHs and 14.4 for dioxins/furans. The original Oeser Site ERA concluded that a population-level risk to insectivorous mammals from chemicals in soil was unlikely for various reasons. This conclusion appears unsupportable now that additional contamination hotspots have been identified and the LOAEL-based hazard quotients for the shrew exceed 14 for both total PAHs and dioxins/furans. Lastly, dioxin/furans in soil in the LCS ravine appear to be at a threshold for adverse effects to insectivorous songbirds such as the American Robin; the LOAEL-based hazard quotient for this receptor was found to be 1 for dioxins/furans in this reevaluation.
- Aquatic Life in Little Squalicum Creek -- The original Oeser Site ERA concluded that contaminant levels in water and sediment in 1999 did not pose a serious threat to aquatic biota in the creek. More recent data from Ecology (2004) and Integral (2005) suggest otherwise. Ecology (2004) observed significant benthic toxicity at several creek sampling locations where sediment PAH levels were high. Integral (2005) presented data suggesting that PCP was

being released to the creek from the Oeser Company Site and resulting in PCP concentrations in creek water that exceed the NAWQC for PCP. In general, it appears that conditions in LSC have worsened since the creek was sampled in 1999 for the Oeser Company Site RI.

#### Are Ecological Risks in Little Squalicum Park Actionable Under CERCLA?

- **South Slope Soil** No ecological risks are posed by levels of Oeser-related chemicals in soils on the south slope. Hence, no action is needed in this area.
- Soil in the Little Squalicum Creek Ravine Remediation appears warranted to address soil contamination in the historic and upper creek areas. Surface and subsurface soils in these areas are highly contaminated with PAHs. The contamination is great enough to pose risks to plants, soil invertebrates, and insectivorous mammals. In addition, dioxin/furan levels in surface and subsurface soils in the historic, upper, and lower creek areas are great enough to pose risks to insectivorous mammals, and should be considered for remedial action.
- Sediment in Little Squalicum Creek -- In E & E's experience, the benthic toxicity documented in some areas of the creek in 2003 by Ecology (2004) could be considered actionable under CERCLA. At other Superfund sites, sediment remediation is being undertaken to protect benthic life. For example, at the Onondaga Lake Superfund Site in Syracuse, New York, sediment-bioassay data were used to develop site-specific sediment benchmarks that subsequently were used to delineate areas of the lake bottom in need of dredging and/or capping (EPA 2005).
- Surface Water in Little Squalicum Creek Surface water data collected in 2005 by Integral suggest that PCP is being released to the creek from Oeser's activities and resulting in concentrations in creek water in excess of NAWQC. Typically, exceedances of NAWQC create a regulatory imperative for action under CERCLA because they are applicable or relevant and appropriate requirements (ARARs).

#### Is Additional Ecological Risk Assessment Work Warranted?

- Little Squalicum Creek -- Additional sampling of creek sediment and/or surface water for analysis of chemical parameters and/or toxicity is not recommended. The data collected by Ecology in 2003 illustrate that levels of contamination in LSC can increase to a point that results in mortality of aquatic life, and that chemicals used by the Oeser Company are present.
- Little Squalicum Creek Ravine No additional work is recommended to further evaluate soils contamination in the LSC ravine. E & E's conclusion that actionable levels of soil contamination are present is based on risks to three assessment endpoints—plants, soil invertebrates, and insectivorous wildlife. For

these three assessment endpoints, risk thresholds for total PAHs have been exceeded by a factor of ten or more. Although additional evaluation may provide a more accurate estimate of risk, it seems unlikely that the overall conclusion of this reassessment would be altered by additional data.

#### Remediation and Risk Reduction

Figures 1 and 2 identify sample locations that drive ecological risks for total PAHs and dioxins/furans, respectively, at the site. The sample locations shown on Figures 1 and 2 correspond with the shaded concentrations presented in Tables 3 and 4, respectively. A similar figure for PCP was not generated because ecological risks from PCP are minimal compared with total PAHs and dioxins/furans.

Figure 1 identifies 10 locations where total PAH levels in soil between 0 and 6 ft bgs are elevated above risk-based benchmarks for plants (20 mg/kg) and/or soil fauna (30 mg/kg). These ten locations also contribute most to wildlife risk from total PAHs. Remediation of soil at the locations and depths shown on Figure 1 would eliminate risks to plants and soil fauna and reduce wildlife risk to an acceptable level (i.e., the LOAEL-based HQ for the shrew would be reduced from 15.8 to 0.24) from total PAHs. Remediation of sediment at locations LSC02 and LSC03 in the LSC channel would address the locations where Ecology (2004) found that survival of benthic invertebrates was reduced by 25% or more compared with controls; Ecology (2004) considers this level of mortality to be a "cleanup screening level" exceedance. Based on data presented in Ecology (2004), PAHs appeared to be the causative agent of toxicity at locations LSC02 and LSC03.

Figure 2 identifies 12 locations where dioxins/furans in soil between 0 and 6 ft bgs contribute significantly to risk to mammalian wildlife, the group most sensitive to dioxins/furans. Remediation of soil at the locations and depths shown on Figure 2 would reduce the risk to mammalian wildlife to an acceptable level (i.e., the LOAEL-based HQ for the shrew would be reduced from 14.4 to 1).

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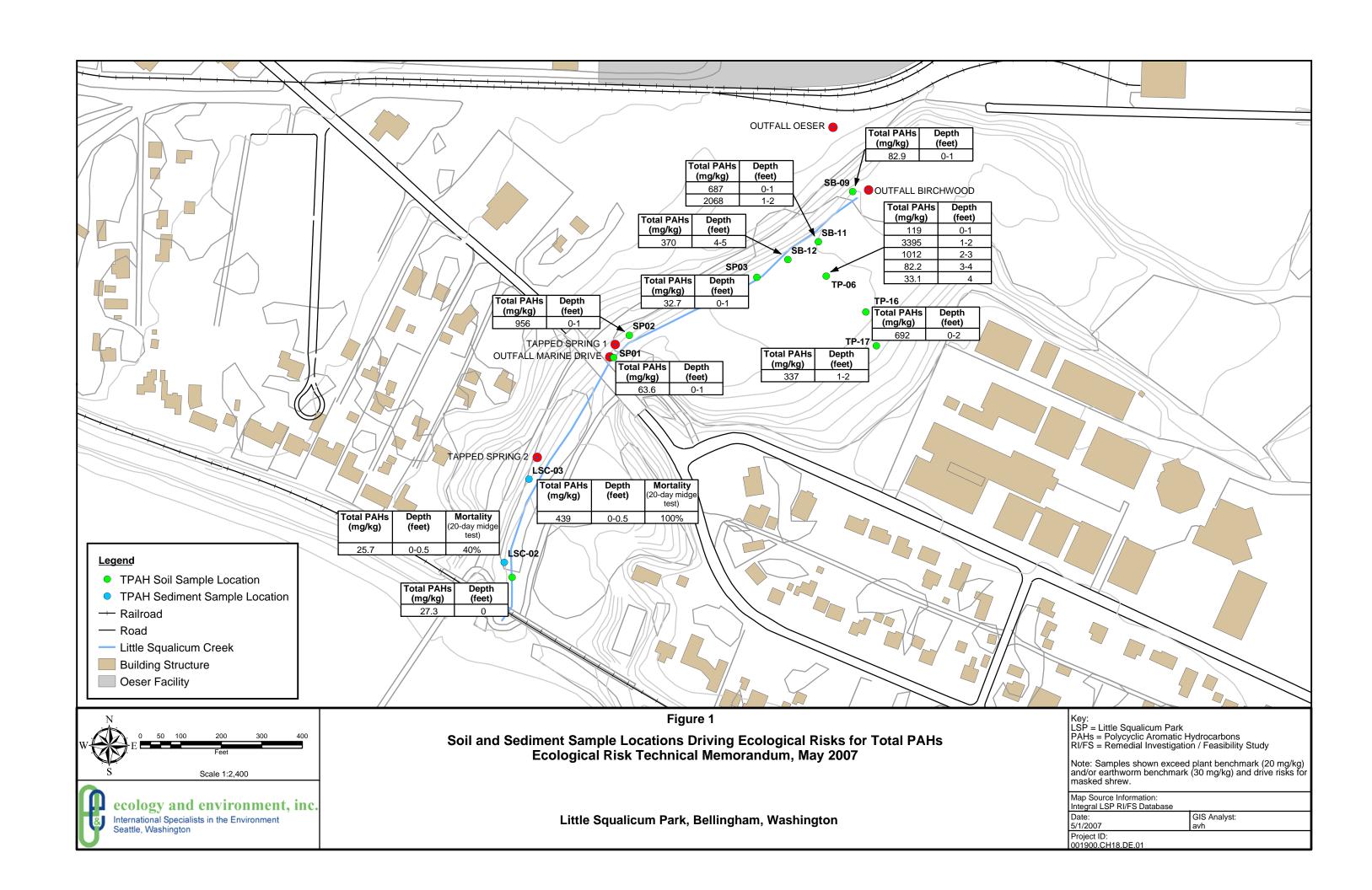
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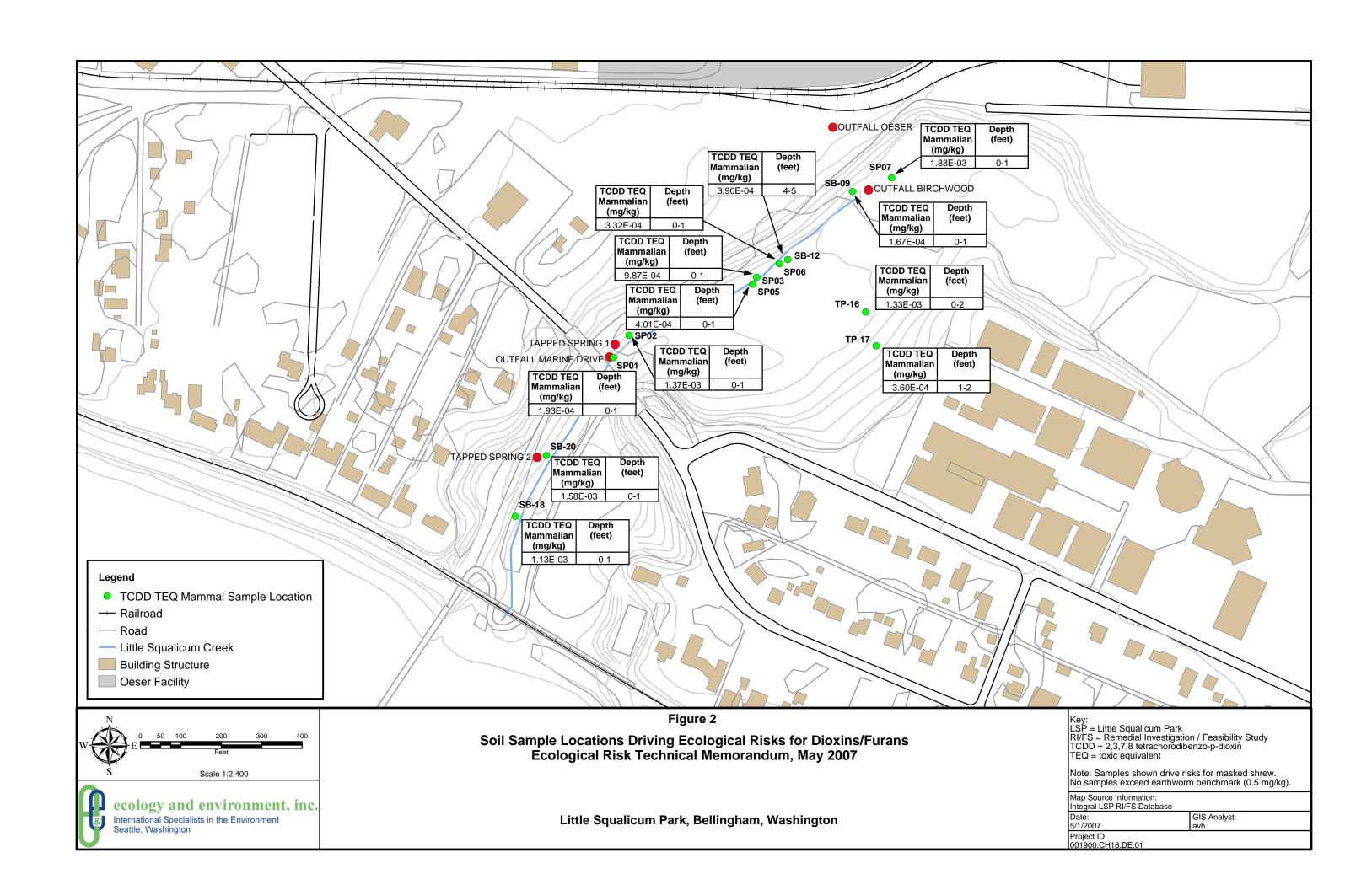
## Ecological Risk Actionability Technical Memorandum Oeser Company Superfund Site

Prepared by Ecology and Environment, Inc. for EPA Region 10

May 2, 2007

**FIGURES** 





## Ecological Risk Actionability Technical Memorandum Oeser Company Superfund Site

Prepared by Ecology and Environment, Inc. for EPA Region 10

May 2, 2007

**TABLES** 

Summary of Comparisons of Little Squalicum Park Soils Data with Phytotoxicity and Soil-Fauna Screening Benchmarks Oeser Company Site Ecological Risk Assessment Table 1

Chemical	Phytotoxicity	Earthworm	Soil Microbe	il Microbe Summary of Comparisons for	Summary of Comparisons for
	Benchmark (mg/kg) <sup>2</sup>	Benchmark (mg/kg) <sup>3</sup>	Benchmark (mg/kg) <sup>3</sup>	South Slope	Little Squalicum Creek Ravine
PCP	က	9	400	No benchmark exceeded.	Phytotoxicity benchmark exceeded at three locations in the historic and lower creek areas (see Table 2 for locations and concentrations). Earthworm benchmark exceeded at one location in the historic creek area (see Table 2). Soil microbe benchmarks not exceeded.
Total PAHs	20	30		No benchmark exceeded.	Phytotoxicity and earthworm benchmarks exceeded at 10 and nine locations, respectively, in the historic, upper, and lower creek areas (see Table 3 for locations and concentrations).
TCDD TEQ	-	0.5	-	Benchmark not exceeded.	Benchmark not exceeded.

- (dash) = not available

bgs = below ground surface

PAHs = polycyclic aromatic hydrocarbons

PCP = pentachlorophenol

TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalent concentration.

# Notes:

- 1. Based on surface and subsurface (up to 6 feet bgs) soil samples from the Little Squalicum Park RI/FS database. See Tables 2 to 5 for data used.

  2. Efroymson et al. (1997b). Phytotoxicity benchmark listed for total PAHs is for acenaphthalene, the only PAH for which a benchmark is available in Efroymson et al. (1997a) for PCP and total PAHs. USEPA (1999) for TCDD TEQ. Earthworm benchmark listed for total PAHs is for fluorene, the only PAH for which a benchmark
  - is available in Efroymson et al. (1997a).

Table 2. PCP Analytical Data for Surface and Subsurface (up to 6 feet bgs) Soil Samples from Little Squalicum Park.

Site Area	Location	Sample ID	Sample Date	Upper Depth	Lower Depth	Depth Unit	Analyte	ERA Value (mg/kg)	Database Value (mg/kg)	Qualifier
Upper creek	TT01-BW	99070649	08/05/99	2.5	2.5	U	PCP	0.0048	0.0095	П
Upper creek	TT01-SW	99070648	08/05/99	4.0	4.0		PCP	0.005	0.003	
South Slope	B-BB5	99070593	08/06/99	4.0	6.0	ft	PCP	0.0055	0.011	
South Slope	B-BB5	99070536	08/03/99	0.0	0.17	ft	PCP	0.0055	0.011	
Upper creek	MWLSC04	99070538	08/02/99	4.0	6.0	11	PCP	0.0055	0.011	
Upper creek	SP04	99070653	08/06/99	0.0	0.0		PCP	0.0055	0.011	
Upper creek	MWLSC03	99070513	08/05/99	0.0	0.5		PCP	0.0056	0.0056	
South Slope	B-BB3	99070535	08/03/99	0.0	0.17	ft	PCP	0.0036	0.0030	
South Slope	B-BB3	99070596	08/06/99	2.0		ft	PCP	0.0065	0.012	
South Slope	B-AA4	99070533	08/03/99	0.0	0.17		PCP	0.0005	0.0085	
South Slope	B-AA6	99070533	08/03/99	0.0	0.17	-	PCP	0.0065	0.0065	
South Slope	B-AA2			0.0	0.17		PCP			
		99070532	08/03/99				PCP	0.015	0.015	J
Upper creek	MWLSC02	99070512	08/05/99	0.0	0.17		_	0.015	0.015	
Historical creek	TP-06	LSP0047	11/08/05	3.0	4.0	ft	PCP	0.0225	0.045	
Historical creek	TP-06	LSP0048	11/08/05	4.0	4.0		PCP	0.023	0.046	
Landfill	TP-23	LSP0110	01/31/06	3.5	4.0	ft	PCP	0.023	0.046	
Upper creek	SB-14	LSP0220	02/08/06	5.0	6.0		PCP	0.0235	0.047	UJ
Upper creek	MWLSC01	99070511	08/05/99	0.0	0.17	ft	PCP	0.026	0.026	
Upper creek	SB-14	LSP0219	02/08/06	4.0	5.0	ft	PCP	0.05	0.1	
Historical creek	TP-21	LSP0102	11/17/05	0.0	2.0	ft	PCP	0.07	0.14	
Upper creek	SP02	99070651	08/06/99	0.0	0.0		PCP	0.075	0.15	
Historical creek	TP-06	LSP0046	11/08/05	2.0		ft	PCP	0.18	0.18	
Upper creek	SB-11	LSP0274	02/11/06	0.0	1.0	ft	PCP	0.24	0.24	-
South Slope	RES-43	99224021	05/25/99	0.0		ft	PCP	0.3305	0.661	
General Site	RES-49	99224035	05/26/99	0.0	0.17	ft	PCP	0.339	0.678	
Landfill	TP-23	LSP0108	01/31/06	0.0	2.0	ft	PCP	0.35	0.35	J
General Site	RES-47A	99224036	05/26/99	0.0	0.17	ft	PCP	0.3565	0.713	U
Upper creek	SB-09	LSP0213	02/08/06	0.0	1.0	ft	PCP	0.375	0.375	
Upper creek	SB-29	LSP0464	04/06/06	5.0	5.5	ft	PCP	0.38	0.38	
General Site	RES-48	99224034	05/26/99	0.0	0.17	ft	PCP	0.3905	0.781	U
Lower creek	SB-20	LSP0271	02/10/06	0.0	1.0	ft	PCP	0.4	0.4	
Upper creek	MWLSC04	99070514	08/05/99	0.0	0.5		PCP	0.41	0.41	
Lower creek	SB-18	LSP0250	02/10/06	0.0	1.0	ft	PCP	0.41	0.41	J
South Slope	RES-46	99224022	05/25/99	0.0	0.17	ft	PCP	0.4765	0.953	U
Upper creek	SB-11	LSP0275	02/11/06	1.0	2.0	ft	PCP	0.5	1	UJ
Historical creek	TP-17	LSP0090	11/16/05	1.0	2.0	ft	PCP	0.54	0.54	J
Upper creek	LSC-S2	03394048	09/25/03	0.0	0.0		PCP	0.673	0.673	J
Upper creek	SP01	99070650	08/06/99	0.0	0.0		PCP	1.1	1.1	
Historical creek	TP-06	LSP0044	11/08/05	0.0	1.0	ft	PCP	1.1	1.1	J
Upper creek	SB-12	LSP0201	02/07/06	4.0	5.0	ft	PCP	1.2	1.2	
Upper creek	SP05	99070654	08/06/99	0.0	0.0		PCP	1.2	1.2	
Upper creek	SP06	99070655	08/06/99	0.0	0.0		PCP	1.4	1.4	J
Upper creek	SP03	99070652	08/06/99	0.0	0.0		PCP	1.8	1.8	
General Site	SP07	99070656	08/06/99	0.0	0.0		PCP	2.2	2.2	J
Historical creek	TP-06	LSP0045	11/08/05	1.0	2.0	ft	PCP	3.5	3.5	-
Lower creek	LSC-S1	03394047	09/25/03	0.0	0.0	-	PCP	5.96	5.96	J
Historical creek	TP-16	LSP0088	11/16/05	0.0	2.0	ft	PCP	7.1	7.1	
i iiotorioai oreek	111 10		11/10/03	0.0	2.0	l.,,	Mean ->	0.71	7.1	
							IVICALI ->	0.71		

Source: Integral project database for draft Little Squalicum Park RI/FS.

Min -> 0.005 Max -> 7.10 Count -> 47

Key:

bgs = below ground surface PCP = pentachlorophenol

shading = concentration exceeds phytotoxicity benchmark (3 mg/kg) and/or earthworm benchmark (6 mg/kg).

Table 3. Total PAH Analytical Data for Surface and Subsurface (up to 6 feet bgs) Soil Samples from Little Squalicum Park.

Site Area	Location	Sample ID	Sample Date	Upper	Lower	Depth	Analyte	Value Qu	Qualifier
Upper creek	TT01-BW	99070649	66/50/80	2.5	2.5		TPAHS (ND = 1/2 DL)	U 610.0	
Jpper creek	MWLSC04	99070538	08/02/99	4	9		TPAHS (ND = 1/2 DL)	0.021 U	
South Slope	B-BB5	99070593	66/90/80	4	6.00	ft	TPAHs (ND = 1/2 DL)	0.022 U	
Jpper creek	SP04	99070653	66/90/80	0	0		TPAHs (ND = 1/2 DL)	0.022 UJ	
South Slope	B-BB3	99070596	66/90/80	2	4.00	ft	TPAHs (ND = 1/2 DL)	0.025 U	
South Slope	B-AA6	99070534	66/20/80	0	0.17	ft	TPAHs (ND = $1/2$ DL)	0.056 J	
South Slope	B-BB5	99070536	66/20/80	0	0.17	ft	TPAHS (ND = $1/2$ DL)	0.059	
Jpper creek	MWLSC03	99070513	08/02/80	0	0.5		TPAHS (ND = 1/2 DL)	0.082	
South Slope	B-AA4	99070533	08/03/88	0	0.17	<b>=</b>	TPAHS (ND = $1/2$ DL)	0.084	
South Slope	B-BB3	99070535	08/03/88	0	0.17	Į,	TPAHS (ND = 1/2 DL)	0.089	
South Slope	B-AA2	99070532	66/03/80	0	0.17	Įţ	TPAHS (ND = 1/2 DL)	0.112 J	
Jpper creek	TT01-SW	99070648	08/02/80	4	4		TPAHS (ND = 1/2 DL)	0.151	
Seneral Site	RES-48	99224034	66/92/50	0	0.17	± 3	TPAHS (ND = 1/2 DL)	0.312 U	
-andfill	1P-23	LSP0110	01/31/06	3.5	4	<u>1</u>	IPAHS (ND = 1/2 DL)	0.366 J	
Jpper creek	MWLSC02	99070512	66/90/80	0	0.17	Į,	TPAHS (ND = 1/2 DL)	0.437	
Jpper creek	SB-14	LSP0219	02/08/06	4	5	ft	TPAHS (ND = $1/2$ DL)	0.770	
andfill-	TP-23	LSP0108	01/31/06	0	2	Į,	TPAHS (ND = $1/2$ DL)	0.983	
Jpper creek	MWLSC04	99070514	08/02/99	0	0.5		TPAHS (ND = 1/2 DL)	1.145 J	
Jpper creek	MWLSC01	99070511	08/02/80	0	0.17	ft	TPAHS (ND = 1/2 DL)	1.183 J	
General Site	RES-49	99224035	05/26/99	0	0.17	ft	TPAHS (ND = 1/2 DL)	1.570 J	
South Slope	RES-43	99224021	02/52/68	0	0.17	ft	TPAHS (ND = 1/2 DL)	1.638	
Seneral Site	RES-47A	99224036	66/97/90	0	0.17	ĮĮ.	TPAHS (ND = 1/2 DL)	1.716	
South Slope	RES-46	99224022	66/52/90	0	0.17	ĮĮ.	TPAHS (ND = 1/2 DL)	1.877	
Jpper creek	SB-14	LSP0220	05/08/06	5	6	ft	TPAHS (ND = 1/2 DL)	3.835	
ower creek	SB-18	LSP0250	02/10/06	0	1	ft	TPAHS (ND = $1/2$ DL)	4.498	
ower creek	SB-20	LSP0271	02/10/06	0	1	ft	TPAHS (ND = 1/2 DL)	C 099.9	
Jpper creek	SP06	99070655	66/90/80	0	0		TPAHs (ND = 1/2 DL)	8.017	
Jpper creek	SP05	99070654	66/90/80	0	0		TPAHS (ND = 1/2 DL)	8.585	
Jpper creek	LSC-S2	03394048	09/25/03	0	0		TPAHS (ND = 1/2 DL)	10.80	
Jpper creek	SB-29	LSP0464	04/06/06	5	5.5	ft	TPAHS (ND = $1/2$ DL)	12.72 J	
Historical creek	TP-21	LSP0102	11/17/05	0	2	ft	TPAHs (ND = 1/2 DL)	18.78	
General Site	SP07	93070656	66/90/80	0	0		TPAHS (ND = 1/2 DL)	18.97	
ower creek	LSC-S1	03394047	09/25/03	0	0		TPAHS (ND = $1/2$ DL)	27.25 J	
Jpper creek	SP03	99070652	66/90/80	0	0		TPAHS (ND = $1/2$ DL)	32.70	
Historical creek	TP-06	LSP0048	11/08/05	4	4	ft	TPAHs (ND = 1/2 DL)	33.07	
Jpper creek	SP01	99070650	66/90/80	0	0		TPAHS (ND = 1/2 DL)	63.60	
Historical creek	TP-06	LSP0047	11/08/05	3	4	ft	TPAHS (ND = 1/2 DL)	82.18	
Jpper creek	SB-09	LSP0213	05/08/06	0	1	ft	TPAHS (ND = 1/2 DL)	82.86	
Historical creek	TP-06	LSP0044	11/08/05	0	1	ft	TPAHS (ND = 1/2 DL)	119.0	
Historical creek	TP-17	LSP0090	11/16/05	1	2	14	TPAHS (ND = 1/2 DL)	337.0	
Jpper creek	SB-12	LSP0201	02/01/06	4	5	ĮĮ.	TPAHS (ND = 1/2 DL)	370.3	
Jpper creek	SB-11	LSP0274	02/11/06	0	1	ft	TPAHS (ND = 1/2 DL)	U 0.789	
Historical creek	TP-16	LSP0088	11/16/05	0	2	JJ	TPAHs (ND = $1/2$ DL)	692.3	
Jpper creek	SP02	99070651	66/90/80	0	0		TPAHs (ND = 1/2 DL)	956.4 J	
Historical creek	TP-06	LSP0046	11/08/05	2	3	ĮĮ.	TPAHS (ND = 1/2 DL)	1012.2	
Jpper creek	SB-11	LSP0275	02/11/06	1	2	ĮĮ.	TPAHS (ND = 1/2 DL)	2067.6	
Historical creek	TP-06	LSP0045	11/08/05	1	2	ft	TPAHS (ND = 1/2 DL)	3394.7	
							Mean ->		
: Integral pi	oject database f	for draft Little S	Source: Integral project database for draft Little Squalicum Park RI/FS	RI/FS.			^ Win -		
1	,						- Max	336	
= below gre	bgs = below ground surface	-					count ->	4/	
TO I OF	olio promotio byo	rocarbone							

Source: Integral project database for draft Little Squalicum Park RI/FS.

Max

Key:

bgs = below ground surface

PAHs = polycyclic aromatic hydrocarbons

shading = concentration exceeds phytotoxicity benchmark (20 mg/kg) and/or earthworm benchmark (30 mg/kg).

Table 4. Mammalian 2,3,7,8 TCDD Toxic Equivalent (TEQ) Concentrations in Surface and Subsurface (up to 6 feet bgs) Soil from LSP.

Qualifier					٦								n					٦		٦	٦	ſ			ſ	ſ		ſ	
Mammalian TEQ Value (mg/kg)	8.499E-07	1.486E-06	2.551E-06	4.695E-06	5.130E-06	5.802E-06	90-396E-06	90-3298'9	7.246E-06	9.441E-06	1.076E-05	1.400E-05	1.450E-05	2.356E-05	2.944E-05	7.814E-05	1.271E-04	1.677E-04	1.927E-04	3.320E-04	3.589E-04	3.897E-04	4.012E-04	9.867E-04	1.133E-03	1.333E-03	1.372E-03	1.581E-03	1.877E-03
Analyte Group	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans	Dioxins_Furans																				
Depth Unit			1,	jj	14	14	ft	14	14	14	14		9 tt	14	14	14		14			2 ft	1,			ĮĮ	2 ft		ft	
Lower Depth	2.5	0	0.16667	0.16667	0.16667 ft	0.16667	0 0.16667	0 0.16667 ft	0.16667	0.16667 ft	0.16667	0.5	9	0.16667	0.16667 ft	0.16667	0.5	1	0	0	2	5 ft	0	0	1	2	0	1	0
Upper Depth	2.5	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	-	4	0	0	0	0	0	0	0
Sampling Date	66/50/80	66/90/80	02/26/99	66/20/80	02/52/99	02/56/99	02/56/99	66/20/80	66/20/80	66/20/80	66/20/80	66/50/80	66/90/80	66/90/80	66/50/80	02/22/68	66/90/80	05/08/06	66/90/80	66/90/80	11/16/05	02/01/06	66/90/80	66/90/80	02/10/06	11/16/05	66/90/80	02/10/06	66/90/80
Sample ID	99070649	99070653	99224036	98902066	99224022	99224035	99224034	99070535	99070533	99070534	99070532	99070513	99070593	99070512	99070511	99224021	99070514	LSP0213	99070650	99070655	CSP0090	LSP0201	99070654	99070652	LSP0250	LSP0088	99070651	LSP0271	99070656
Location	TT01-BW	SP04	RES-47A	B-BB5	RES-46	RES-49	RES-48	B-BB3	B-AA4	B-AA6	B-AA2	MWLSC03	B-BB5	MWLSC02	MWLSC01	RES-43	MWLSC04	SB-09	SP01	SP06	TP-17	SB-12	SP05	SP03	SB-18	TP-16	SP02	SB-20	SP07
Site_Area	Upper creek	Upper creek	General Site	South Slope	South Slope	General Site	General Site	South Slope	South Slope	South Slope	South Slope	Upper creek	South Slope	Upper creek	Upper creek	South Slope	Upper creek	Upper creek	Upper creek	Upper creek	Historical creek	Upper creek	Upper creek	Upper creek	Lower creek	Historical creek	Upper creek	Lower creek	General Site

Source: Integral database for draft Little Squalicum Park RI/FS.

3.61E-04 8.49876E-07 1.88E-03 Mean --> Min --> Max --> Count -->

Key:
LSP = Little Squalicum Park
Shading = contributes significantly to mammlian wildlife risk
TEQ = 2,3,7,8 TCDD toxic equivalent
TCDD = tetrachlorodibenzo-p-dioxin

Table 5. Avian 2,3,7,8 TCDD Toxic Equivalent (TEQ) Concentrations in Surface and Subsurface (up to 6 feet bgs) Soil from LSP.

Site_Area	Location	Sample ID	Sampling Date	Upper Depth	Lower	Depth Unit	Analyte Group	Avain TEQ Value (mq/kg)	Qualifier
Jpper creek	TT01-BW	99070649	66/20/80	2.5	2.5		Dioxins_Furans	1.077E-06	
Jpper creek	SP04	99070653	66/90/80	0	0		Dioxins_Furans	1.105E-06	
South Slope	RES-46	99224022	66/52/50	0	0.16667 ft	ft	Dioxins_Furans	7.679E-06	_
South Slope	B-BB3	99070535	66/20/80	0	0.16667	ft	Dioxins_Furans	3.907E-06	
General Site	RES-47A	99224036	66/97/20	0	0.16667	ft	Dioxins_Furans	4.322E-06	
South Slope	B-BB5	98070536	66/20/80	0	0.16667	ft	Dioxins_Furans	4.880E-06	
South Slope	B-AA2	99070532	66/£0/80	0	0.16667	ft	Dioxins_Furans	4.882E-06	
South Slope	B-AA4	99070533	66/20/80	0	0 0.16667 ft	ft	Dioxins_Furans	90-3888·9	
South Slope	B-AA6	99070534	66/20/80	0	0 0.16667 ft	ft	Dioxins_Furans	90-B2E-06	
General Site	RES-49	99224035	66/97/20	0	0 0.16667 ft	ft	Dioxins_Furans	8.324E-06	
Seneral Site	RES-48	99224034	66/97/20	0	0.16667 ft	ft	Dioxins_Furans	1.025E-05	
Jpper creek	MWLSC03	99070513	66/90/80	0	0.5		Dioxins_Furans	1.126E-05	
South Slope	B-BB5	99070593	66/90/80	4	9	ft	Dioxins_Furans	1,450E-05	_
Jpper creek	MWLSC02	99070512	66/20/80	0	0.16667	ft	Dioxins_Furans	1.599E-05	
Jpper creek	MWLSC01	99070511	66/90/80	0	0.16667	ft	Dioxins_Furans	1.990E-05	
Jpper creek	SP01	99070650	66/90/80	0	0		Dioxins_Furans	4.525E-05	
Jpper creek	MWLSC04	99070514	66/90/80	0	0.5		Dioxins_Furans	5.662E-05	
Jpper creek	SB-09	LSP0213	05/08/06	0	1	ft	Dioxins_Furans	6.048E-05	ſ
South Slope	RES-43	99224021	02/52/60	0	0.16667 ft	ft	Dioxins_Furans	6.522E-05	
Jpper creek	SB-12	LSP0201	05/01/06	4	2	ft	Dioxins_Furans	1.237E-04	ſ
listorical creek	TP-17	LSP0090	11/16/05	1	2	ft	Dioxins_Furans	1.420E-04	ſ
Jpper creek	SP06	99070655	66/90/80	0	0		Dioxins_Furans	1.485E-04	ſ
pper creek	SP05	99070654	66/90/80	0	0		Dioxins_Furans	1.892E-04	
Jpper creek	SP03	99070652	66/90/80	0	0		Dioxins_Furans	3.069E-04	
listorical creek	TP-16	LSP0088	11/16/05	0	2	ft	Dioxins_Furans	3.898E-04	ſ
Jpper creek	SP02	99070651	66/90/80	0	0		Dioxins_Furans	5.012E-04	
ower creek	SB-18	LSP0250	05/10/06	0	1	ft	Dioxins_Furans	5.444E-04	_
Seneral Site	SP07	93070656	66/90/80	0	0		Dioxins_Furans	7.745E-04	
Lower creek	SB-20	LSP0271	05/10/06	0	1	ft	Dioxins_Furans	8.058E-04	ſ
							Mean>	1.47E-04	
: Integral da	tabase for drai	Source: Integral database for draft Little Squalicum Park RI/FS.	ım Park RI/FS.				Win>	1.07654E-06	
							Max>	8.06E-04	
							Count>	29	

Key: LSP = Little Squalicum Park TEQ = 2,3,7,8 TCDD toxic equivalent TCDD = tetrachlorodibenzo-p-dioxin

Table 6
Comparison of Original and Updated Exposure Point Concentrations, Exposure Estimates, and Hazard Quotients for the American Robin and Masked Shrew
Oeser Company Site Ecological Risk Assessment

Parameter	Units		an Robin	Maske	ed Shrew
		Original <sup>1</sup>	Updated <sup>2</sup>	Original <sup>1</sup>	Updated <sup>2</sup>
Pentachlorophenol					
Soil EPC	mg/kg	0.392	0.71	0.392	0.71
Soil-to-worm BAF	unitless	0.98	0.98	0.98	0.98
Earthworm EPC	mg/kg	0.384	0.70	0.384	0.70
EE-diet	mg/kg-day	0.348	0.634	0.410	0.747
EE-soil	mg/kg-day	0.036	0.067	0.054	0.099
EE-total	mg/kg-day	0.384	0.701	0.463	0.846
LOAEL	mg/kg-day	na	na	3.86	3.86
HQ-LOAEL	unitless	na	na	0.12	0.22
Total PAHs					
Soil EPC	mg/kg	46.08	214.1	46.08	214.1
Soil-to-worm BAF	unitless	0.98	0.98	0.98	0.98
Earthworm EPC	mg/kg	45.16	209.8	45.16	209.8
EE-diet	mg/kg-day	40.91	190.1	48.17	223.8
EE-soil	mg/kg-day	4.27	20.2	6.32	30.0
EE-total	mg/kg-day	45.18	210.3	54.49	253.8
LOAEL	mg/kg-day	400	400	16.1	16.1
HQ-LOAEL	unitless	0.11	0.53	3.4	15.8
Dioxins/Furans					
Soil EPC	ng/kg	65.53	147	145.5	361
Soil-to-worm BAF	unitless	0.98	0.98	0.98	0.98
Earthworm EPC	ng/kg	64.23	144.1	142.6	354
EE-diet	ng/kg-day	58.2	127.8	152.1	377.4
EE-soil	ng/kg-day	6.07	13.9	19.96	50.5
EE-total	ng/kg-day	64.3	141.7	172.1	427.9
LOAEL	ng/kg-day	140	140	29.7	29.7
HQ-LOAEL	unitless	0.46	1.0	5.8	14.4

Kev.

BAF = Bioaccumulation Factor

EPC = Exposure point concentration

EE-soil = Estimated exposure from incidental soil ingestion

EE-diet = Estimated exposure from diet (100% earthworms assumed)

EE-total = Estimated total exposure (EE-diet + EE-soil)

HQ-LOAEL = Hazard quotient based on LOAEL

LOAEL = Lowest observed adverse effect level PAHs = Polycyclic aromatic hydrocarbons Shading = HQ exceeds 1.0

#### Footnotes:

- 1. From the ecological risk assessment (Appendix N) for the Oeser Company Site Remedial Investigation (dated April 2002). In the original assessment, 24 surface soil samples from the Little Squalicum Creek ravine and south slope were used to assess risks to terrestrial wildlife.
- 2. Based on surface and subsurface (up to 6 feet below ground surface) soil samples from the Little Squalicum Park RI/FS database assembled by Integral Consulting, Inc. See Tables 2 through 5 for data used.

# Cost Estimates





## Table D1. Cost Estimate for Alternative 2, Option A: Excavation and Offsite Disposal at a Subtitle D (Non-Hazardous Waste) Landfill

### Assumptions:

- 1. Alternative 2, Option A:
  - Contaminated material will be excavated from the existing creek channel and the historical creek channel and disposed offsite.
  - Excavated contaminated areas will be backfilled with clean material.
  - The estuary area is assumed to be clean and will be used as the borrow area for clean backfill material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Contaminated material is considered non-hazardous waste for offsite disposal
- 2. Assume construction duration of 8 weeks.
- Surveying:
- Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
- Surveying during construction: assume 2-man crew for 16 field days (2 days per week) and 2-man crew for 8 office days.
- Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- 4. Total area to clear and grub (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area + borrow area (estuary area)
  - = 25,102 SF + 54,261 SF + 1 acre = 122,923 SF (2.82 acres).
- 5. Clear and grub: assume 1 acre light trees to 6" diameter; remaining 1.82 acres light brush.
- 6. Assume excavated soil/sediment will be loaded directly into a dump truck and hauled to a location at the LSC Site (to be determined) for dewatering and stockpiling.
- 8. Total excavation volume (per calculations) = existing creek channel excavation volume + historical creek channel excavation volume = 3,134 CY + 6,979 CY = 10,113 BCY (bank, in-place).
- 9. Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 11,630 LCY (loose, excavated). 10. Total contaminated material excavation area (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area = 79,363 SF (8,818 SY).
- 11. Total contaminated material excavation perimeter (per AutoCAD) = 3,852 ft + 1,407 ft = 5,259 ft.
- 12. Assume a water diversion system will be in place during excavation of the existing creek channel: the system will consist of a pump behind an earthen dam at the upstream end of the excavation, from which water will be pumped through a hose to a settling pond at the downstream end of the excavation.
- 13. Assume excavated soil/sediment dewatering area will have an area of 500 SF, consisting of an impervious liner overlain by a 6-inch layer of sand, and five 10 ft x 10 ft drying cells constructed with Ecology blocks. Assume a perforated pipe will line the base of the drying area, draining to a pump, which will pump the water to a Baker tank. Water collected in the Baker tank will be tested for proper disposal.
  - Volume of sand needed = 500 SF x (6/12) ft = 250 CF (approx. 10 CY).

7. Assume site access through the Bellingham Technical College (BTC) access.

- Assume sand density = 1.5 tons/CY; therefore, 15 tons sand needed.
- Assume drying cell walls will consist of two stacked layers of Ecology blocks. Ecology block dimensions are 2 ft x 2 ft x 6 ft; therefore, four blocks are needed per cell wall.
- 11 walls x 4 blocks = 44 Ecology blocks.
- Dewatering water testing is included in "Offsite lab analysis," below.
- Assume the majority of water collected in the Baker tank tests clean and can be discharged to the creek. Assume a vacuum truck makes a total of four trips (four hours per trip) to pick up contaminated dewatering water for disposal.
- Costs for the drainage pipe, and sand spreading and compaction are minimal, and are therefore not included in this estimate
- Assume excavated soil/sediment density = 1.3 tons/CY (excavated); therefore, 15,119 tons for offsite disposal.
- Assume excavated soil/sediment will be loaded from the stockpile at the LSC Site onto trucks for transport to disposal facility.
- With a total of 11,630 CY for offsite disposal, assuming 20-CY dump trucks will be used, approximately 582 truck loads will be taken offsite for disposal.
- Assume excavated soil/sediment will be transported to the Greater Wenatchee Landfill (Subtitle D, non-hazardous waste) for disposal.
- 15. For restoration of the existing creek channel excavation area following excavation and backfill, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed within the creek channel, and the remaining backfilled area will be revegetated. For restoration of the historical creek excavation area and estuary area, assume the entire backfilled area will be revegetated.
  - Habitat mix area (per AutoCAD, approx.) = 8,000 SF (890 SY).
  - Volume of habitat mix material needed = 8,000 SF x (3/12) ft = 2,000 CF (74 CY).
  - Assume habitat mix material density = 1.3 tons/CY; therefore, 96 tons habitat mix material needed.
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
  - Total area to be revegetated = (25,102 SF 8,000 SF) + 54,261 SF + 1 acre = 114,923 SF (2.64 acres).
- 16. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1 acre (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
  - Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- 17. For construction oversight and onsite analytical testing
- Assume two oversight engineers (40 hours per week for 8 weeks); one chemist to perform onsite field screening (40 hours per week for 8 weeks); one project engineer (10 hours per week for 8 weeks); and one chief engineer (5 hours per week for 8 weeks).
- 18. Onsite field screening: - Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab.
- Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 79,363 SF/625 SF = 127 sample locations. Assume three samples per sample location = 381 samples.
- Assume 400 samples total 19. Offsite lab analysis:

HCCD Crew A-7, 2-man office

Electric Install

Telephone - 2 lines

- Contamination delineation confirmation samples (soil/sediment): 20% of 400 samples = 80 samples.
- Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of total excavation area = 79,363 SF/625 SF = 127 samples. Assume 150 samples total.
- Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 5,259 ft/25 ft = 210 samples. Assume 220 samples total.

3

Subtota

- Characterization samples (for offsite disposal of soil/sediment): in case existing analytical data is not sufficient for characterization, assume one sample per every 500 cubic yards = 11,630 CY/500 CY = 24 samples. - Characterization samples (for discharge of dewatering water): assume 20 samples.
- UNIT UNIT **EQUIP** Description QTY LABOR **MTRL** TOTAL TOTAL Reference GENERAL Plans and Submittals Construction Operations Plan, Quality Control Plan, and Safety Plan \$10,000 **Engineering Estimate** LS \$10,000 Subtota Pre-Construction Surveying \$1,656.51 \$80.97 HCCD Crew A-7, 3-man field 3 Day \$1,737 \$5,212 **HCCD Crews**

\$1,015.12

Day

EA

WK

\$1,015.12

\$150

\$100

\$3,045

\$8,300

\$300

\$1,600

Surveying During Construction						
HCCD Crew A-7, 2-man field	16	Day	\$1,015.12 \$80.97	\$1,096.08	\$17,500	HCCD Crews
HCCD Crew A-7, 2-man office	8	Day	\$1,015.12	\$1,015.12	\$8,121	HCCD Crews
Subto	tal				\$25,600	
Post-Construction Surveying						
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51 \$80.97	\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	5	Day	\$1,015.12	\$1,015.12	\$5,076	HCCD Crews
Subto	tal				\$10,300	
Quality Control During Construction						
Quality Control (e.g., compaction testing)		LS			\$15,000	Engineering Estimate
Subto	tal				\$15,000	
MOBILIZATION/DEMOBILIZATION	_					
Site Superintendent	8	WK	\$2,835	\$2,835	\$22,679	HCCD 01 31 13.20 0260
Clerk	8	WK	\$607	\$607	\$4,855	HCCD 01 31 13.20 0020
Project Manager	8	WK	\$3,074	\$3,074	\$24,595	HCCD 01 31 13.20 0200
Field Engineer	8	WK	\$1,861	\$1,861	\$14,885	HCCD 01 31 13.20 0120
Trailers (incl air conditioning) - 2	4	MO	\$278	\$278	\$1,113	HCCD 01 52 13.20 0350
Electric	8	WK		\$200	\$1,600	Engineering Estimate

Portable Toilet - 2	4	MO	\$	197.51	\$198	\$790	HCCD 01 54 33 40 6410
Field Office Expenses	4	MO	\$	179.03	\$179	\$716	HCCD 01 52 13.40 0100
Subtotal						\$73,100	
EXCAVATION							
Clear and Grub							
Cut and chip light trees to 6" diameter	1.00	Acre	\$2,555.36 \$1	,501.50	\$4,057	\$4,057	HCCD 31 11 10.10 0020
Grub stumps and remove	1.00	Acre	\$670.78 \$1	,114.58	\$1,785	\$1,785	HCCD 31 11 10.10 0150
Clear light brush with dozer	1.82	Acre	\$466.35 \$	623.70	\$1,090	\$1,984	HCCD 31 13 13.10 0300
Subtotal						\$7,800	
Excavation of Contaminated Areas and Stockpiling for Dewatering		•		·			
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY capacity	10,113	BCY	\$0.72	\$1.04	\$1.76	\$17,781	HCCD 31 23 16.42 0260
For loading onto trucks, add 15%						\$2,667	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	11,630	LCY	\$1.21	\$1.84	\$3.05	\$35,474	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	11,630	LCY	\$0.54	\$0.35	\$0.89	\$10,345	HCCD 31 23 23.25 6045
Subtotal						\$66,300	
Diversion of Water During Excavation of the Existing Creek Channel		•		·			
4" diaphragm pump - pumping $8$ hrs, attended $2$ hrs/day, incl. $20$ LF suction hose and $100$ LF discharge hose	160	Day	\$182.07	27.14	\$209.21	\$33,474	HCCD 31 23 19.20 0650

**HCCD Crews** 

Engineering Estimate

**Engineering Estimate** 

Table D1. Cost Estimate for Alternative 2, Option A: Excavation	n and Off	site Dispo	sal at a Su	ibtitle D (No	on-Hazardous Waste		
Subtotal						\$33,500	
Excavated Soil/Sediment Dewatering	500	QE.			¢0.40	¢200	V 1 0 4
200 mil geocomposite, biplanar, double-sided, 8 oz., installed Sand, stockpiled onsite	500 12	SF Ton			\$0.40 \$7.60	\$200 \$91	Vendor Quote Vendor Quote
Ecology blocks	44	EA			\$60	\$2,640	Vendor Quote
2" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction hose and 100 LF discharge hose	40	Day	\$182.07	\$19.46	\$201.53	\$8,061	HCCD 31 23 19.20 0600
Baker tank rental (for water from soil/sediment dewatering); one 21,000- gallon tank	2	МО			\$1,176	\$2,352	Vendor Quote
Liquid (dewatering water) pickup, vacuum truck, stainless steel tank, min charge, 4 hours, 1 compartment, 2200 gallon	16	HR			\$131	\$2,091	HCCD 02 81 20.10 3110
Subtotal  Excavation from Borrow Area (Estuary Area) and Backfill of Excavatee	I Contomin	atad Arass				\$15,400	
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY				44.04	04.54	0.5.501	11000 01 00 15 10 00 50
capacity	10,113	BCY	\$0.72	\$1.04	\$1.76	\$17,781	HCCD 31 23 16.42 0260
For loading onto trucks, add 15% Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	11,630	LCY	\$1.21	\$1.84	\$3.05	\$2,667 \$35,474	HCCD 31 23 16.42 0020 HCCD 31 23 23.20 1014
wait/load/travel/unload Front end loader, wheel mounted, 3 CY bucket - for backfill material	11,630	LCY	\$0.54	\$0.35	\$0.89	\$10,345	HCCD 31 23 23.15 6045
management	ŕ						
Finish grading slopes, gentle Compaction - riding, vibrating roller, 6" lifts, 2 passes	8,818 11,630	SY LCY	\$0.11 \$0.24	\$0.69 \$0.18	\$0.80 \$0.42	\$7,097 \$4,935	HCCD 31 22 16.10 3300 HCCD 31 23 23.23 5000
Subtotal	11,030	LCI	\$0.24	\$0.16	φ0.42	\$78,300	HCCD 31 23 23.23 3000
DISPOSAL Offsite Disposal at Greater Wenatchee Landfill (Subtitle D, non-haz)	15,119	Ton			\$23	\$345,620	Vendor Quote
Transportation to landfill by truck	15,119	Ton			\$35	\$529,165	Vendor Quote  Vendor Quote
Environmental fee	582	Load			\$8	\$4,652	Vendor Quote
Fuel surcharge	10	%				\$87,479	Vendor Quote
Washington refuse tax	3.6	%				\$31,492	Vendor Quote
Subtotal RESTORATION						\$998,400	
3-Inch Habitat Mix Layer Within Creek Channel							
Habitat mix material, stockpiled onsite	96	Ton			\$11.35	\$1,092	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck	74	LCY	\$0.54	\$0.35	\$0.89	\$66	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	74	LCY	\$1.21	\$1.84	\$3.05	\$226	HCCD 31 23 23.20 1014
wait/load/travel/unload				·		· ·	
Spread dumped material - by dozer, no compaction Finish grading slopes, gentle	74 890	LCY SY	\$0.73 \$0.11	\$1.25 \$0.69	\$1.98 \$0.80	\$147 \$716	HCCD 31 23 23.17 0020 HCCD 31 22 16.10 3300
Subtotal	670	51	\$0.11	ψ0.02	\$0.80	\$2,200	11CCD 31 22 10.10 3300
Revegetation						<b>\$2,2</b> 00	
Seeding	2.64	Acre			\$1,700	\$4,488	Vendor Quote
Fertilizer	2.64	Acre			\$500	\$1,320	Vendor Quote
Subtotal						\$5,800	
Wetland Restoration/Mitigation  Total cost to restore/mitigate wetlands	1.50	Acre			\$70,000	\$105,000	Engineering Estimate
Subtotal	1.50	Acic			\$70,000	\$105,000	Liighteering Estimate
CONSTRUCTION MONITORING COSTS						\$105,000	
Construction Oversight							
Oversight Engineers	640	HR	\$85.00			\$54,400	Engineering Estimate
Senior Chemist Project Engineer	320 80	HR HR	\$90.00 \$120.00			\$28,800 \$9,600	Engineering Estimate Engineering Estimate
Chief Engineer	40	HR	\$120.00			\$6,000	Engineering Estimate  Engineering Estimate
Subtotal			7-2-0100			\$98,800	
Analytical Testing - Onsite Field Screening (soil/sediment)	I					Ψ>0,000	
RaPID ® PCP Test Kits (50 tests per kit)	8	Kit			\$830	\$6,640	Vendor Quote
RaPID ® PAH Test Kits (50 tests per kit)	8	Kit			\$1,675	\$13,400	Vendor Quote
RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)	8 34	Kit Kit			\$1,675 \$185	\$13,400 \$6,290	Vendor Quote Vendor Quote
RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for							
cPAHs)	34	Kit			\$185	\$6,290	Vendor Quote
Rental: SDI RaPID ® Accessory Kit	2	MO			\$2,200	\$4,400	Vendor Quote
Subtotal						\$50,400	
Analytical Testing - Offsite Lab for Confirmation Testing	450	Tr. ·			h1 < 7	P74.050	V1. O
PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151)	450 450	Test Test			\$165 \$145	\$74,250 \$65,250	Vendor Quote Vendor Quote
Dioxin/Furans (EPA Method 8290)	450	Test			\$675	\$303,750	Vendor Quote  Vendor Quote
Deliverables (EDD and Hardcopy)	-	LS				\$66,488	Vendor Quote
Subtotal						\$509,700	
Analytical Testing - Offsite Lab for Characterization Testing	2:	T =	1		+	<b>#2.2.</b>	
PAH and PCP (soil) PAH and PCP (dewatering)	24 20	Test			\$165 \$165	\$3,960 \$3,300	Vendor Quote Vendor Quote
PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)	20	Test LS			\$105	\$3,300 \$1,089	Vendor Quote  Vendor Quote
Subtotal						\$8,300	
CONSTRUCTION SUBTOTAL						\$2,122,200	
Construction Contingency	25	%				\$530,600	EPA FS Guidance
SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)						\$2,652,800	
Project Management		%				\$159,200	EPA FS Guidance
D 14.1 D 1	12	%				\$318,400	EPA FS Guidance
Removal Action Design		0/				C212 200	LIDA EC Cardonos
Construction Management		%				\$212,300 <b>\$689.900</b>	EPA FS Guidance
		%				\$212,300 \$689,900 \$3,342,700	EPA FS Guidance

References:

R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance).

## Table D2. Cost Estimate for Alternative 2, Option B: Excavation and Offsite Disposal at a Subtitle C (Hazardous Waste) Landfill

### Assumptions:

- 1. Alternative 2, Option B:
- Contaminated material will be excavated from the existing creek channel and the historical creek channel and disposed offsite.
- Excavated contaminated areas will be backfilled with clean material.
- The estuary area is assumed to be clean and will be used as the borrow area for clean backfill material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Contaminated material is considered non-hazardous waste for offsite disposal
   Assume construction duration of 8 weeks.
- 3. Surveying:
- Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
- Surveying during construction: assume 2-man crew for 16 field days (2 days per week) and 2-man crew for 8 office days.
- Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- 4. Total area to clear and grub (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area + borrow area (estuary area)
  - $= 25{,}102\;SF + 54{,}261\;SF + 1\;acre = 122{,}923\;SF\;(2.82\;acres).$
- 5. Clear and grub: assume 1 acre light trees to 6" diameter; remaining 1.82 acres light brush.
- Assume excavated soil/sediment will be loaded directly into a dump truck and hauled to a location at the LSC Site (to be determined) for dewatering and stockpiling.
   Assume site access through the Bellingham Technical College (BTC) access.
- 8. Total excavation volume (per calculations) = existing creek channel excavation volume + historical creek channel excavation volume = 3,134 CY + 6,979 CY = 10,113 BCY (bank, in-place).
- 9. Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 11,630 LCY (loose, excavated).

  10. Total contaminated material excavation area (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area = 79,363 SF (8,818 SY).
- 11. Total contaminated material excavation perimeter (per AutoCAD) = 3,852 ft + 1,407 ft = 5,259 ft.
- 12. Assume a water diversion system will be in place during excavation of the existing creek channel: the system will consist of a pump behind an earthen dam at the upstream end of the excavation, from which water will be pumped through a hose to a settling pond at the downstream end of the excavation.
- 13. Assume excavated soil/sediment dewatering area will have an area of 500 SF, consisting of an impervious liner overlain by a 6-inch layer of sand, and five 10 ft x 10 ft drying cells constructed with Ecology blocks. Assume a perforated pipe will line the base of the drying area, draining to a pump, which will pump the water to a Baker tank. Water collected in the Baker tank will be tested for proper disposal.
  - Volume of sand needed = 500 SF x (6/12) ft = 250 CF (approx. 10 CY).
  - Assume sand density = 1.5 tons/CY; therefore, 15 tons sand needed.
  - Assume drying cell walls will consist of two stacked layers of Ecology blocks. Ecology block dimensions are 2 ft x 2 ft x 6 ft; therefore, four blocks are needed per cell wall.
  - 11 walls x 4 blocks = 44 Ecology blocks.
  - Dewatering water testing is included in "Offsite lab analysis," below.
  - Assume the majority of water collected in the Baker tank tests clean and can be discharged to the creek. Assume a vacuum truck makes a total of four trips (four hours per trip) to pick up contaminated dewatering water for disposal.
- Costs for the drainage pipe, and sand spreading and compaction are minimal, and are therefore not included in this estimate
- 14. Offsite Disposal:
  - Assume excavated soil/sediment density = 1.3 tons/CY (excavated); therefore, 15,119 tons for offsite disposal.
  - Assume excavated soil/sediment will be loaded from the stockpile at the LSC Site onto trucks for transport to disposal facility.
  - With a total of 11,630 CY for offsite disposal, assuming 20-CY dump trucks will be used, approximately 582 truck loads will be taken offsite for disposal.
  - $Assume\ excavated\ soil/sediment\ will\ be\ transported\ to\ the\ Arlington\ Landfill\ (Subtitle\ C,\ hazardous\ waste)\ for\ disposal.$
- 15. For restoration of the existing creek channel excavation area following excavation and backfill, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed within the creek channel, and the remaining backfilled area will be revegetated. For restoration of the historical creek excavation area and estuary area, assume the entire backfilled area will be revegetated.
  - Habitat mix area (per AutoCAD, approx.) = 8,000 SF (890 SY).
  - Volume of habitat mix material needed = 8,000 SF x (3/12) ft = 2,000 CF (74 CY).
  - Assume habitat mix material density = 1.3 tons/CY; therefore, 96 tons habitat mix material needed.
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
  - Total area to be revegetated = (25,102 SF 8,000 SF) + 54,261 SF + 1 acre = 114,923 SF (2.64 acres).
- 16. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1 acre (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
- Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- 17. For construction oversight and onsite analytical testing
- Assume two oversight engineers (40 hours per week for 8 weeks); one chemist to perform onsite field screening (40 hours per week for 8 weeks); one project engineer (10 hours per week for 8 weeks); and one chief engineer (5 hours per week for 8 weeks).
- 18. Onsite field screening:
  - Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab.
  - Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 79,363 SF/625 SF = 127 sample locations. Assume three samples per sample location = 381 samples.
- Assume 400 samples total
- 19. Offsite lab analysis:
  - Contamination delineation confirmation samples (soil/sediment): 20% of 400 samples = 80 samples.
  - Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of excavation = 79,363 SF/625 SF = 127 samples. Assume 150 samples total.
  - Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 5,259 ft/25 ft = 210 samples. Assume 220 samples total.
  - Characterization samples (for discharge of dewatering water): assume 20 samples.

Description	ОТУ	UNIT	LABOR	EOUIP	MTRL	UNIT TOTAL	TOTAL	Reference
GENERAL	QII	UNII	LADOK	LQUII	MIIKE	TOTAL	TOTAL	Receive
Plans and Submittals								
Construction Operations Plan, Quality Control Plan, and Safety Plan		LS					\$10,000	Engineering Estimate
Subtotal							\$10,000	
Pre-Construction Surveying							φ10,000	
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	3	Day	\$1,015.12			\$1,015.12	\$3,045	HCCD Crews
Subtotal		Ĭ					\$8,300	
Surveying During Construction							φ0,500	
HCCD Crew A-7, 2-man field	16	Day	\$1,015.12	\$80.97		\$1.096.08	\$17,500	HCCD Crews
HCCD Crew A-7, 2-man office	8	Day	\$1,015.12	\$00.7 <i>1</i>		\$1,015.12	\$8,121	HCCD Crews
Subtotal			7-,0			7 7,0 30 11 2	\$25,600	
Post-Construction Surveying							\$23,000	
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 3-man ried	5	Day	\$1,030.31	ψ00.71		\$1,015.12	\$5,076	HCCD Crews
Subtotal		Duy	Ψ1,013.12			Ψ1,010.12	\$10,300	need ciews
Quality Control During Construction							\$10,300	
Quality Control (e.g., compaction testing)		LS					\$15,000	Engineering Estimate
		Lo						Engineering Estimate
Subtotal   MOBILIZATION/DEMOBILIZATION							\$15,000	
Site Superintendent	8	WK	\$2,835			\$2,835	\$22,679	HCCD 01 31 13.20 0260
Clerk	8	WK	\$607			\$607	\$4,855	HCCD 01 31 13.20 0200 HCCD 01 31 13.20 0020
Project Manager	8	WK	\$3,074			\$3,074	\$24,595	HCCD 01 31 13.20 0020
Field Engineer	8	WK	\$1,861			\$1,861	\$14,885	HCCD 01 31 13.20 0200
Trailers (incl air conditioning) - 2	4	MO	φ1,001	\$278		\$278	\$1,113	HCCD 01 52 13.20 0350
Electric	8	WK		<i>\$2,0</i>		\$200	\$1,600	Engineering Estimate
Electric Install	2	EA				\$150	\$300	Engineering Estimate
Felephone - 2 lines	16	WK				\$100	\$1,600	Engineering Estimate
Portable Toilet - 2	4	MO		\$197.51		\$198	\$790	HCCD 01 54 33 40 6410
Field Office Expenses	4	MO		\$179.03		\$179	\$716	HCCD 01 52 13.40 0100
Subtotal							\$73,100	
EXCAVATION							, ,	
Clear and Grub								
Cut and chip light trees to 6" diameter	1.00	Acre	\$2,555.36	\$1,501.50		\$4,057	\$4,057	HCCD 31 11 10.10 0020
Grub stumps and remove	1.00	Acre	\$670.78	\$1,114.58		\$1,785	\$1,785	HCCD 31 11 10.10 0150
Clear light brush with dozer	1.82	Acre	\$466.35	\$623.70		\$1,090	\$1,984	HCCD 31 13 13.10 0300
Subtotal							\$7,800	
Excavation of Contaminated Areas and Stockpiling for Dewatering								
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	10,113	BCY	\$0.72	\$1.04		\$1.76	\$17,781	HCCD 31 23 16.42 0260
capacity	10,113	ВСТ	\$0.72	\$1.04		\$1.70		
For loading onto trucks, add 15%							\$2,667	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	11,630	LCY	\$1.21	\$1.84		\$3.05	\$35,474	HCCD 31 23 23.20 1014
wait/load/travel/unload	,000		7-121	···		72.00	,	
	11,630	LCY	\$0.54	\$0.35		\$0.89	\$10,345	HCCD 31 23 23.25 6045
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	•		1				•	
Subtotal			]				\$66,300	
Diversion of Water During Excavation of the Existing Creek Channel		1						
4" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction	160	Day	\$182.07	\$27.14		\$209.21	\$33,474	HCCD 31 23 19.20 0650
hose and 100 LF discharge hose		,	1				•	

Table D2. Cost Estimate for Alternative 2, Option B: Excavatio	n and Offs	site Dispo	sal at a Su	btitle C (Ha	zardous Waste) Land	ifill	
Subtotal				,		\$33,500	
Excavated Soil/Sediment Dewatering		1			1		
200 mil geocomposite, biplanar, double-sided, 8 oz., installed	500	SF			\$0.40	\$200	Vendor Quote
Sand, stockpiled onsite Ecology blocks	12 44	Ton EA			\$7.60 \$60	\$91 \$2,640	Vendor Quote Vendor Quote
2" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction			*****	***			
hose and 100 LF discharge hose	40	Day	\$182.07	\$19.46	\$201.53	\$8,061	HCCD 31 23 19.20 0600
Baker tank rental (for water from soil/sediment dewatering); one 21,000- gallon tank	2	MO			\$1,176	\$2,352	Vendor Quote
Liquid (dewatering water) pickup, vacuum truck, stainless steel tank, min charge, 4 hours, 1 compartment, 2200 gallon	16	HR			\$131	\$2,091	HCCD 02 81 20.10 3110
Subtotal						\$15,400	
Excavation from Borrow Area (Estuary Area) and Backfill of Excavated	Contamin	ated Areas					
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY capacity	10,113	BCY	\$0.72	\$1.04	\$1.76	\$17,781	HCCD 31 23 16.42 0260
For loading onto trucks, add 15%						\$2,667	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	11,630	LCY	\$1.21	\$1.84	\$3.05	\$35,474	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for backfill material management	11,630	LCY	\$0.54	\$0.35	\$0.89	\$10,345	HCCD 31 23 23.15 6045
Finish grading slopes, gentle	8,818	SY	\$0.11	\$0.69	\$0.80	\$7,097	HCCD 31 22 16.10 3300
Compaction - riding, vibrating roller, 6" lifts, 2 passes	11,630	LCY	\$0.24	\$0.18	\$0.42	\$4,935	HCCD 31 23 23.23 5000
Subtotal DISPOSAL						\$78,300	
Offsite Disposal at Arlington Landfill (Subtitle C, haz)	15,119	Ton			\$120	\$1,814,280	Vendor Quote
Transportation to landfill by truck	15,119	Ton			\$62	\$937,378	Vendor Quote
Environmental fee	15,119	Ton			\$12	\$181,428	Vendor Quote
Fuel surcharge	10	% T			#20	\$275,166	Vendor Quote
Oregon Department of Environmental Quality tax	15,119	Ton			\$30	\$453,570 \$3,661,800	Vendor Quote
Subtotal RESTORATION						\$3,001,800	
3-Inch Habitat Mix Layer Within Creek Channel							
Habitat mix material, stockpiled onsite	96	Ton			\$11.35	\$1,092	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck	74	LCY	\$0.54	\$0.35	\$0.89	\$66	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	74	LCY	\$1.21	\$1.84	\$3.05	\$226	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction	74	LCY	\$0.73	\$1.25	\$1.98	\$147	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	890	SY	\$0.11	\$0.69	\$0.80	\$716	HCCD 31 22 16.10 3300
Subtotal						\$2,200	
Dovogototion							
Revegetation Sanding	2.64	Aoro			\$1.700	\$4.400	Vandar Quata
Seeding	2.64 2.64	Acre Acre			\$1,700 \$500	\$4,488 \$1.320	Vendor Quote Vendor Quote
Seeding Fertilizer	2.64 2.64	Acre Acre			\$1,700 \$500	\$1,320	Vendor Quote Vendor Quote
Seeding Fertilizer Subtotal Wetland Restoration/Mitigation						\$1,320 \$5,800	Vendor Quote
Seeding Fertilizer Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands						\$1,320 \$5,800 \$105,000	
Seeding Fertilizer Subtotal Wetland Restoration/Mitigation	2.64	Acre			\$500	\$1,320 \$5,800	Vendor Quote
Seeding Fertilizer Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands Subtotal	2.64	Acre			\$500	\$1,320 \$5,800 \$105,000	Vendor Quote  Engineering Estimate
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers	1.50	Acre Acre HR	\$85.00		\$500	\$1,320 \$5,800 \$105,000 \$105,000	Vendor Quote  Engineering Estimate  Engineering Estimate
Seeding Fertilizer Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands Subtotal CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist	2.64 1.50 640 320	Acre Acre HR	\$90.00		\$500	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800	Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation  Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers	1.50	Acre Acre HR			\$500	\$1,320 \$5,800 \$105,000 \$105,000	Vendor Quote  Engineering Estimate  Engineering Estimate
Seeding Fertilizer Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist Project Engineer	2.64 1.50 640 320 80	Acre Acre HR HR	\$90.00 \$120.00		\$500	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600	Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation  Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist  Project Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)	2.64 1.50 640 320 80 40	Acre Acre HR HR HR	\$90.00 \$120.00		\$70,000	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)	2.64 1.50 640 320 80 40	Acre Acre HR HR HR Kit	\$90.00 \$120.00		\$70,000 \$70,000 \$830	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)	2.64  1.50  640 320 80 40	Acre Acre HR HR HR Kit Kit	\$90.00 \$120.00		\$70,000 \$70,000 \$830 \$1,675	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)	2.64 1.50 640 320 80 40	Acre Acre HR HR HR Kit	\$90.00 \$120.00		\$70,000 \$70,000 \$830	\$1,320 \$5,800 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for	2.64  1.50  640 320 80 40  8 8 8 34	Acre  Acre  HR  HR  HR  Kit  Kit  Kit  Kit	\$90.00 \$120.00		\$500 \$70,000 \$830 \$1,675 \$1,675 \$185	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist  Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit; same extraction kit for cPAHs)	2.64  1.50  640 320 80 40  8 8 8 34 34	Acre  Acre  HR HR HR Kit Kit Kit Kit Kit	\$90.00 \$120.00		\$500 \$70,000 \$830 \$1,675 \$1,675 \$185 \$185	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist  Project Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit	2.64  1.50  640 320 80 40  8 8 8 34	Acre  Acre  HR  HR  HR  Kit  Kit  Kit  Kit	\$90.00 \$120.00		\$500 \$70,000 \$830 \$1,675 \$1,675 \$185	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400	Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit	2.64  1.50  640 320 80 40  8 8 8 34 34	Acre  Acre  HR HR HR Kit Kit Kit Kit Kit	\$90.00 \$120.00		\$500 \$70,000 \$830 \$1,675 \$1,675 \$185 \$185	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing	2.64  1.50  640 320 80 40  8 8 8 34 34	Acre  Acre  HR HR HR Kit Kit Kit Kit Kit	\$90.00 \$120.00		\$500 \$70,000 \$830 \$1,675 \$1,675 \$185 \$185	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit	2.64  1.50  640 320 80 40  8 8 8 34 34	Acre  Acre  HR HR HR Kit Kit Kit Kit Kit MO	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$185 \$2,200	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist  Project Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290)	2.64  1.50  640 320 80 40  8 8 8 34 34 2	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151)  Dioxin/Furans (EPA Method 8290)  Deliverables (EDD and Hardcopy)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test Test LS	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test LS  Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151)  Dioxin/Furans (EPA Method 8290)  Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing  PAH and PCP (dewatering)  Deliverables (EDD and Hardcopy)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test LS  Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450	Acre  Acre  HR HR HR HR Kit Kit Kit Kit Test Test LS  Test	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing  PAHs (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing  PAH and PCP (dewatering)  Deliverables (EDD and Hardcopy)  Subtotal  CONSTRUCTION SUBTOTAL  Construction Contingency  SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)	2.64  1.50  640 320 80 40  8 8 8 34 34 2  450 450 450	Acre  Acre  HR HR HR HR HR  Kit Kit Kit Kit Test Test LS  Test LS	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,85 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$495 \$3,800 \$4,781,100 \$1,195,300 \$5,976,400	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote EVendor Quote Vendor Quote Vendor Quote
Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)  Subtotal CONSTRUCTION SUBTOTAL Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management	2.64  1.50  640 320 80 40  8 8 8 8 34 34 2  450 450 450  20	Acre  Acre  HR HR HR HR HR  Kit Kit Kit Kit Test Test LS  Test LS  %	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800 \$4,781,100 \$1,195,300 \$5,976,400 \$358,600	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  EPA FS Guidance
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)  Subtotal  CONSTRUCTION SUBTOTAL  Construction Contingency  SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design	2.64  1.50  640 320 80 40  8 8 8 8 34 34 2  450 450 450  20  25	Acre  Acre  HR HR HR HR HR  Kit Kit Kit Kit Kit  Kit  Kit  Kit  K	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800 \$4,781,100 \$1,195,300 \$5,976,400 \$358,600 \$717,200	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote EVendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote EVendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (10 tests per kit)  RaPID ® PAH Extraction Extraction tits (10 tests per kit)  RaPID ® PAH Extraction RaPID ® PAH Extraction RaPID P	2.64  1.50  640 320 80 40  8 8 8 8 34 34 2  450 450 450  20	Acre  Acre  HR HR HR HR HR  Kit Kit Kit Kit Test Test LS  Test LS  %	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$54,400 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800 \$4,781,100 \$1,195,300 \$5,976,400 \$358,600	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  EPA FS Guidance
Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)  Subtotal  CONSTRUCTION SUBTOTAL  Construction Contingency  SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design	2.64  1.50  640 320 80 40  8 8 8 8 34 34 2  450 450 450  20  25	Acre  Acre  HR HR HR HR HR  Kit Kit Kit Kit Kit  Kit  Kit  Kit  K	\$90.00 \$120.00		\$830 \$1,675 \$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145 \$675	\$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800 \$4,781,100 \$1,195,300 \$5,976,400 \$358,600 \$717,200 \$478,200	Engineering Estimate  Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote EVendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote EVendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote

References:

R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance).

### Assumptions

### Alternative 2, Option C:

- Contaminated material will be excavated from the existing creek channel and the historical creek channel and consolidated on the Oeser property in an engineered repository.
- Excavated contaminated areas will be backfilled with clean material.
- The estuary area is assumed to be clean and will be used as the borrow area for clean backfill and repository cover material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Assume construction duration of 8 weeks.
- Surveying:
  - Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
- Surveying during construction: assume 2-man crew for 16 field days (2 days per week) and 2-man crew for 8 office days. - Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- Total area to clear and grub (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area + borrow area (estuary area)
- $= 25{,}102\;SF + 54{,}261\;SF + 1\;acre = 122{,}923\;SF\;(2.82\;acres).$ Clear and grub: assume 1 acre light trees to 6" diameter; remaining 1.82 acres light brush.
- Assume excavated soil/sediment will be loaded directly into a dump truck and hauled to a location at the LSC Site (to be determined) for dewatering and stockpiling.
- Assume site access through the Bellingham Technical College (BTC) access. Total excavation volume (per calculations) = existing creek channel excavation volume + historical creek channel excavation volume = 3,134 CY + 6,979 CY = 10,113 BCY (bank, in-place).
- Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 11,630 LCY (loose, excavated).
- 10. Total contaminated material excavation area (per AutoCAD) = existing creek channel excavation area + historical creek channel excavation area = 79,363 SF (8,818 SY).
- 11. Total contaminated material excavation perimeter (per AutoCAD) = 3,852 ft + 1,407 ft = 5,259 ft. 12. Assume a water diversion system will be in place during excavation of the existing creek channel: the system will consist of a pump behind an earthen dam at the upstream end of the excavation, from which water will be pumped through
- a hose to a settling pond at the downstream end of the excavation. 13. Assume excavated soil/sediment dewatering area will have an area of 500 SF, consisting of an impervious liner overlain by a 6-inch layer of sand, and five 10 ft x 10 ft drying cells constructed with Ecology blocks. Assume a perforated pipe will line the base of the drying area, draining to a pump, which will pump the water to a Baker tank. Water collected in the Baker tank will be tested for proper disposal.
  - Volume of sand needed = 500 SF x (6/12) ft = 250 CF (approx. 10 CY).
  - Assume sand density = 1.5 tons/CY; therefore, 15 tons sand needed.
  - Assume drying cell walls will consist of two stacked layers of Ecology blocks. Ecology block dimensions are 2 ft x 2 ft x 6 ft; therefore, four blocks are needed per cell wall.
  - 11 walls x 4 blocks = 44 Ecology blocks.
  - Dewatering water testing is included in "Offsite lab analysis," below.
- Assume the majority of water collected in the Baker tank tests clean and can be discharged to the creek. Assume a vacuum truck makes a total of four trips (four hours per trip) to pick up contaminated dewatering water for disposal. - Costs for the drainage pipe, and sand spreading and compaction are minimal, and are therefore not included in this estimate.
- 14. For consolidation of excavated soil/sediment in a repository at Oeser property:
- Assume 2 acres (87,120 SF or 9,680 SY) of surface area are available for construction of the repository in the western portion of the Oeser property.

   Assume repository cover will consist of a layer of geotextile demarcation fabric, followed by a 6-inch layer of 4-inch minus rock, followed by a layer of geotextile filter fabric, followed by a 2-foot layer of clean fill material excavated from the Estuary Area.
  - Volume of soil needed = 87,120 SF x 2 ft = 174,240 CF (6,453 CY).
  - Volume of 4-inch minus rock needed = 87,120~SF~x~(6/12)~ft = 43,560~CF~(1,613~CY).
  - Assume 4-inch minus rock density = 1.4 tons/CY; therefore, 2,258 tons 4-inch minus rock needed.
  - Assume 4-inch minus rock material imported and stockpiled at the Oeser property.
- 15. For restoration of the existing creek channel excavation area following excavation and backfill, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed within the creek channel, and the remaining backfilled area will be revegetated. For restoration of the historical creek excavation area and estuary area, assume the entire backfilled area will be revegetated.
  - Habitat mix area (per AutoCAD, approx.) = 8,000 SF (890 SY).
  - Volume of habitat mix material needed = 8.000 SF x (3/12) ft = 2.000 CF (74 CY).
  - Assume habitat mix material density = 1.3 tons/CY; therefore, 96 tons habitat mix material needed.
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
  - Total area to be revegetated = (25,102 SF 8,000 SF) + 54,261 SF + 1 acre = 114,923 SF (2.64 acres).
- 16. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1 acre (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
- Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- Assume two oversight engineers (40 hours per week for 8 weeks); one chemist to perform onsite field screening (40 hours per week for 8 weeks); one project engineer (10 hours per week for 8 weeks); and one chief engineer (5 hours per week for 8 weeks). 18. Onsite field screening:
- Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab. - Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 79,363 SF/625 SF = 127 sample locations. Assume three samples per sample location = 381 samples
- Assume 400 samples total.
- 19. Offsite lab analysis:
  - Contamination delineation confirmation samples (soil/sediment): 20% of 400 samples = 80 samples.
  - Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of excavation = 79,363 SF/625 SF = 127 samples. Assume 150 samples total.
  - Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 5,259 ft/25 ft = 210 samples. Assume 220 samples total
  - Characterization samples (for discharge of dewatering water): assume 20 samples.

Description	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	Reference
GENERAL								
Plans and Submittals								
Construction Operations Plan, Quality Control Plan, and Safety Plan		LS					\$10,000	Engineering Estimate
Subtotal							\$10,000	
Pre-Construction Surveying							, , , , , , , , , , , , , , , , , , , ,	•
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	3	Day	\$1,015.12			\$1,015.12	\$3,045	HCCD Crews
Subtotal							\$8,300	
Surveying During Construction			1				φ0,500	
HCCD Crew A-7, 2-man field	16	Day	\$1,015.12	\$80.97		\$1,096.08	\$17,500	HCCD Crews
HCCD Crew A-7, 2-man office	8	Day	\$1,015.12	\$60.77		\$1,015.12	\$8,121	HCCD Crews
,	0	Duy	φ1,015.12			ψ1,013.12		Heeb crews
Subtotal							\$25,600	
Post-Construction Surveying	2		Φ1 656 51	#00.0 <b>7</b>		D1 505	Ф5 212	HOOD O
ICCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	5	Day	\$1,015.12			\$1,015.12	\$5,076	HCCD Crews
Subtotal							\$10,300	
Quality Control During Construction		_						
Quality Control (e.g., compaction testing)		LS					\$15,000	Engineering Estimate
Subtotal							\$15,000	
MOBILIZATION/DEMOBILIZATION			1	1			ψ12,000	
Site Superintendent	8	WK	\$2,835			\$2,835	\$22,679	HCCD 01 31 13.20 0260
Clerk	8	WK	\$607			\$607	\$4,855	HCCD 01 31 13.20 0220
Project Manager	8	WK	\$3,074			\$3,074	\$24,595	HCCD 01 31 13.20 0200
Field Engineer	8	WK	\$1,861			\$1,861	\$14,885	HCCD 01 31 13.20 0120
Frailers (incl air conditioning) - 2	4	MO	. , ,	\$278		\$278	\$1,113	HCCD 01 52 13.20 0350
Electric	8	WK				\$200	\$1,600	Engineering Estimate
Electric Install	2	EA				\$150	\$300	Engineering Estimate
Selephone - 2 lines	16	WK				\$100	\$1,600	Engineering Estimate
Portable Toilet - 2	4	MO		\$197.51		\$198	\$790	HCCD 01 54 33 40 6410
Field Office Expenses	4	MO		\$179.03		\$179	\$716	HCCD 01 52 13.40 0100
Subtotal							\$73,100	
EXCAVATION							\$73,100	
Clear and Grub								
Cut and chip light trees to 6" diameter	1.00	Acre	\$2,555.36	\$1,501.50		\$4,057	\$4,057	HCCD 31 11 10.10 0020
Grub stumps and remove	1.00	Acre	\$670.78	\$1,114.58		\$1,785	\$1,785	HCCD 31 11 10.10 0020
Clear light brush with dozer	1.82	Acre	\$466.35	\$623.70		\$1,090	\$1,783	HCCD 31 13 13.10 0300
	1.02	Acic	\$400.33	\$023.70		\$1,070		Heeb 31 13 13.10 0300
Subtotal							\$7,800	
Excavation of Contaminated Areas and Stockpiling for Dewatering								
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	10,113	BCY	\$0.72	\$1.04		\$1.76	\$17,781	HCCD 31 23 16.42 0260
rapacity								
For loading onto trucks, add 15%			1				\$2,667	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	11,630	LCY	\$1.21	\$1.84		\$3.05	\$35,474	HCCD 31 23 23.20 1014
vait/load/travel/unload	-		1				*	
	11,630	LCY	\$0.54	\$0.35		\$0.89	\$10,345	HCCD 31 23 23.25 6045
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	,000		7			+ >		22222223313
Subtotal							\$66,300	
Diversion of Water During Excavation of the Existing Creek Channel				1				
" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF	160	Dov	\$182.07	\$27.14		\$209.21	\$33,474	HCCD 31 23 19.20 0650
uction hose and 100 LF discharge hose	100	Day	\$102.07	φ2/.14		φ207.21	φυυ,4/4	11CCD 31 23 19.20 0030
Subtotal							\$33,500	
Excavated Soil/Sediment Dewatering		1	-1	1			·	•
00 mil geocomposite, biplanar, double-sided, 8 oz., installed	500	SF				\$0.40	\$200	Vendor Quote
	12	Ton				\$7.60	\$91	Vendor Quote
vand, stockbiled onsite			+					`
	44	FΑ				\$60	\$2,640	Vendor Onote
Sand, stockpiled onsite  Ecology blocks 2" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF	44	EA Day	\$182.07	\$19.46		\$60 \$201.53	\$2,640 \$8,061	Vendor Quote HCCD 31 23 19.20 0600

Table D3. Cost Estimate for Alternative 2, Option C: Excavation	on and Con	solidation	on the Oe	ser Propert	v		
Baker tank rental (for water from soil/sediment dewatering); one 21,000-	2	MO	on the Oe	sei Fiopen	\$1,176	\$2,352	Vendor Quote
gallon tank Liquid (dewatering water) pickup, vacuum truck, stainless steel tank, min	16	HR			\$131	\$2,091	HCCD 02 81 20.10 3110
charge, 4 hours, 1 compartment, 2200 gallon		пк			\$131	\$15,400	HCCD 02 81 20.10 3110
Subtotal Excavation from Borrow Area (Estuary Area) and Backfill of Excavate		ated Areas				\$15,400	
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY capacity	10,113	BCY	\$0.72	\$1.04	\$1.76	\$17,781	HCCD 31 23 16.42 0260
For loading onto trucks, add 15% Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.						\$2,667	HCCD 31 23 16.42 0020
wait/load/travel/unload	11,630	LCY	\$1.21	\$1.84	\$3.05	\$35,474	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for backfill material management	11,630	LCY	\$0.54	\$0.35	\$0.89	\$10,345	HCCD 31 23 23.15 6045
Finish grading slopes, gentle	8,818	SY LCY	\$0.11	\$0.69	\$0.80 \$0.42	\$7,097	HCCD 31 22 16.10 3300
Compaction - riding, vibrating roller, 6" lifts, 2 passes  Subtotal	11,630	LCI	\$0.24	\$0.18	\$0.42	\$4,935 \$78,300	HCCD 31 23 23.23 5000
Loading and Hauling of Dewatered Excavated Soil/Sediment from the I Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto	LSC Site, an	d Placemer	nt at the Oes	er Property	to be Consolidated in th	e Repository	
dump truck	11,630	LCY	\$0.54	\$0.35	\$0.89	\$10,345	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	11,630	LCY	\$1.21	\$1.84	\$3.05	\$35,474	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction Finish grading slopes, gentle	11,630 9,680	LCY SY	\$0.73 \$0.11	\$1.25 \$0.69	\$1.98 \$0.80	\$23,051 \$7,790	HCCD 31 23 23.17 0020 HCCD 31 22 16.10 3300
Compaction - riding, vibrating roller, 6" lifts, 2 passes	11,630	LCY	\$0.24	\$0.18	\$0.42	\$4,935	HCCD 31 23 23.23 5000
Subtotal REPOSITORY COVER (OESER PROPERTY)	!					\$81,600	
Geotextile demarcation material - for placement between contaminated	9,680	SY			\$0.38	\$3,678	Vendor Quote
material and biotic barrier layer Geotextile filter fabric - for placement between biotic barrier layer and	9,680	SY			\$0.58	\$5,566	Vendor Quote
clean soil	,	51			\$0.50	\$9,200	vendor Quote
Subtotal Excavation from Borrow Area (Estuary Area), Loading, and Hauling t		perty for P	acement in	a 2-Foot La	ver	#2,200	
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY capacity	6,453	BCY	\$0.72	\$1.04	\$1.76	\$11,346	HCCD 31 23 16.42 0260
For loading onto trucks, add 15% Hauling - 12 CY dump truck, 15 mph average, 1 mile cycle, 20 min.						\$1,702	HCCD 31 23 16.42 0020
wait/load/travel/unload	7,421	LCY	\$1.69	\$2.56	\$4.26	\$31,591	HCCD 31 23 23.20 1416
Front end loader, wheel mounted, 3 CY bucket - for backfill material management	7,421	LCY	\$0.54	\$0.35	\$0.89	\$6,601	HCCD 31 23 23.15 6045
Finish grading slopes, gentle Compaction - riding, vibrating roller, 6" lifts, 2 passes	9,680 7,421	SY LCY	\$0.11 \$0.24	\$0.69 \$0.18	\$0.80 \$0.42	\$7,790 \$3,149	HCCD 31 22 16.10 3300 HCCD 31 23 23.23 5000
Subtotal		201	ψ012 ·	Ţ0.10	\$0.12	\$62,200	11000 01 20 20:20 0000
6-Inch Biotic Barrier Layer 4-inch minus rock, stockpiled onsite	2,258	Ton			\$7.85	\$17,725	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck	1,613	CY	\$0.54	\$0.35	\$0.89	\$1,435	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	1,613	CY	\$1.21	\$1.84	\$3.05	\$4,920	HCCD 31 23 23.20 1014
wait/load/travel/unload Spread dumped material - by dozer, no compaction	1,613	CY	\$0.73	\$1.25	\$1.98	\$3,197	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	9,680	SY	\$0.11	\$0.69	\$0.80	\$7,790 \$35,100	HCCD 31 22 16.10 3300
Subtotal						φ33,100	
	_				1	ı	
Seeding	2.00	Acre Acre			\$1,700 \$500	\$3,400 \$1,000	Vendor Quote Vendor Quote
Seeding Fertilizer Subtotal	2.00						•
Seeding Fertilizer Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel	2.00					\$1,000	Vendor Quote
Seeding Fertilizer Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite	2.00	Acre			\$500	\$1,000 \$4,400 \$1,092	Vendor Quote  Vendor Quote
Seeding Fertilizer Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck	2.00	Acre	\$0.54	\$0.35	\$500	\$1,000 \$4,400	Vendor Quote
Seeding Fertilizer  Subtotal  RESTORATION  3-Inch Habitat Mix Layer Within Creek Channel  Habitat mix material, stockpiled onsite  Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck  Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	2.00 96 74 74	Ton LCY LCY	\$1.21	\$1.84	\$11.35 \$0.89 \$3.05	\$1,000 \$4,400 \$1,092 \$66 \$226	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction	2.00 96 74	Ton LCY			\$11.35 \$0.89	\$1,000 \$4,400 \$1,092 \$66	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal	2.00 96 74 74 74 890	Ton LCY LCY LCY	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding	2.00 96 74 74 74 890	Ton LCY LCY LCY	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer	2.00 96 74 74 74 890 2.64 2.64	Ton LCY LCY LCY SY	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300
Seeding Fertilizer  Subtotal  RESTORATION  3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation	2.00 96 74 74 74 890 2.64 2.64	Ton LCY LCY LCY SY	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands	2.00 96 74 74 74 890 2.64 2.64 2.64	Ton LCY LCY LCY SY	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal CONSTRUCTION MONITORING COSTS	2.00 96 74 74 74 890 2.64 2.64 2.64	Ton LCY LCY SY Acre Acre	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal CONSTRUCTION MONITORING COSTS Construction Oversight	2.00 96 74 74 74 890 2.64 2.64 2.64	Ton LCY LCY SY Acre Acre	\$1.21 \$0.73	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist	2.00 96 74 74 74 890 2.64 2.64 1.50	Ton LCY LCY LCY SY Acre Acre	\$1.21 \$0.73 \$0.11	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer	2.00  96  74  74  890  1  2.64  2.64  2.64  2.64  1  640  320  80  40	Acre  Ton LCY LCY SY Acre Acre Acre HR HR	\$1.21 \$0.73 \$0.11 \$0.11 \$85.00 \$90.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer	2.00  96  74  74  890  1  2.64  2.64  2.64  2.64  1  640  320  80  40	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit)	2.00  96  74  74  890  2.64  2.64  2.64  1.50  640  320  80  40  8	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)	2.00  96  74  74  890  2.64  2.64  2.64  320  80  40  8  8  8  8	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR HR Kit Kit Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$9,600 \$9,800 \$13,400 \$13,400	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit)	2.00  96  74  74  890  2.64  2.64  2.64  2.64  1.50  880  40  8  8  8  8  8  8  8	Acre  Ton LCY LCY SY  Acre Acre Acre  HR HR HR HR Kit Kit Kit Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$1,675 \$1,675 \$1,675 \$185	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal CONSTRUCTION MONITORING COSTS Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit; same extraction kit for cPAHs)	2.00  96  74  74  890  2.64  2.64  2.64  2.64  40  320  80  40  40  8  8  8  8  8  34	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR HR Kit Kit Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$1,675 \$1,675 \$1,675 \$185 \$185	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$9,600 \$6,000 \$98,800 \$13,400 \$13,400 \$6,290 \$6,290	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal Revegetation Seeding Fertilizer  Subtotal Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID @ PCP Test Kits (50 tests per kit) RaPID @ Carcinogenic PAH Test Kits (50 tests per kit) RaPID @ PCP Extraction Kits (12 tests per kit; same extraction kit for cPAHs) Rental: SDI RaPID @ Accessory Kit	2.00  96  74  74  890  2.64  2.64  2.64  1.50  8  8  8  8  8  34  34  2	Acre Ton LCY LCY SY Acre Acre Acre HR HR HR HR Kit Kit Kit Kit Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$1,675 \$1,675 \$1,675 \$185	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Subtotal  RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing	2.00  96  74  74  890  2.64  2.64  2.64  1.50  8  8  8  8  8  34  34  2	Acre Ton LCY LCY SY Acre Acre Acre HR HR HR HR Kit Kit Kit Kit Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$1,675 \$1,675 \$1,675 \$185 \$185	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$13,400 \$13,400 \$6,290 \$4,400	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Subtotal  RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer Chief Engineer Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8151)	2.00  96  74  74  890  2.64  2.64  2.64  2.64  2.64  320  80  40  40  450  450  450	Acre  Ton LCY LCY SY  Acre Acre Acre  HR HR HR HR HR HR TIST Kit	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$1,675	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Subtotal  RESTORATION 3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wair/load/travel/unload  Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (51 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit)  RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290)	2.00  96  74  74  890  1.50  640  320  80  40  40  450	Acre  Ton LCY LCY SY  Acre Acre Acre  HR HR HR HR HR HR HR HR Tit Kit Kit Kit Kit Kit Kit Test	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$1,675 \$1,675 \$1,675 \$185 \$185 \$2,200	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$6,000 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$74,250	Vendor Quote  Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  RESTORATION  3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® P	2.00  96  74  74  890  2.64  2.64  2.64  2.64  2.64  2.64  320  80  40  40  450  450  450	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR HR Tist Kit Kit Kit Kit Kit Kit Kit Kit Kit Ki	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$1,675	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$50,400 \$74,250 \$65,250 \$303,750	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  RESTORATION 3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) RaPID ® POP Extraction Kits (12 tests per kit) Ra	2.00  96  74  74  890  2.64  2.64  2.64  2.64  2.64  2.64  320  80  40  40  450  450  450	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR TR HR LS  Test Test LS	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$1,675	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$6,600 \$13,400 \$13,400 \$13,400 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  RESTORATION  3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  CONSTRUCTION MONITORING COSTS  Construction Oversight Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer Chief Engineer Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PCP Method 8200 Deliverables (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering) Deliverables (EDD and Hardcopy)	2.00  96  74  74  890  2.64  2.64  2.64  2.64  320  80  40  40  40  450  450  450  450	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR Trian  Kit Kit Kit Kit Kit Kit Kit Kit Kit Ki	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$16.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.85	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$28,800 \$9,600 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  Subtotal  RESTORATION  3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation  Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  CONSTRUCTION MONITORING COSTS  Construction Oversight  Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Challytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit; same extraction kit for pPAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (E	2.00  96  74  74  890  2.64  2.64  2.64  1.50  8  80  40  40  450  450  450  450  4	Acre  Ton LCY LCY SY  Acre Acre Acre  HR HR HR HR HR LS  Kit Kit Kit Kit Kit Kit Kit Kit Kit Ki	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$16.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.85	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$6,000 \$98,800 \$6,600 \$13,400 \$13,400 \$13,400 \$6,290 \$6,290 \$4,488 \$1,320 \$5,800 \$1,311,400 \$1,340	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  **Subtotal**  **RESTORATION**  3-Inch Habitat Mix Layer Within Creek Channel** Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.  **wait/load/travel/unload** Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  **Subtotal**  **Revegetation** Seeding Fertilizer  **Subtotal**  **Wetland Restoration/Mitigation** Total cost to restore/mitigate wetlands  **Subtotal**  **Wetland Restoration/Mitigation** Total cost to restore/mitigate wetlands  **Subtotal**  **CONSTRUCTION MONITORING COSTS**  Construction Oversight  Oversight Engineers  Senior Chemist  Project Engineer  Chief Engineer  Chief Engineer  **Subtotal**  Analytical Testing - Onsite Field Screening (soil/sediment)  RaPID ® PCP Test Kits (50 tests per kit)  RaPID ® PAH Test Kits (50 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit)  RaPID ® PCP Extraction Kits (12 tests per kit; same extraction kit for cPAHs)  Rental: SDI RaPID ® Accessory Kit  **Subtotal**  Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8151)  Dioxin/Furans (EPA Method 8290)  Deliverables (EDD and Hardcopy)  **Subtotal**  Analytical Testing - Offsite Lab for Characterization Testing PAH and PCP (dewatering)  Deliverables (EDD and Hardcopy)  **Subtotal**  CONSTRUCTION SUBTOTAL**  CONSTRUCTION SUBTOTAL**	2.00  96  74  74  890  2.64  2.64  2.64  1.50  8  80  40  40  450  450  450  450  4	Acre  Ton LCY LCY SY  Acre Acre  Acre  HR HR HR HR HR TR HR LS  Test Test LS	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$16.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.85	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$65,250 \$303,750 \$66,488 \$509,700 \$3,300 \$495 \$3,800 \$1,311,800 \$328,000	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote
Seeding Fertilizer  **RESTORATION** 3-Inch Habitat Mix Layer Within Creek Channel** Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.  **wait/load/travel/unload** Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  **Subtotal**  **Revegetation** Seeding Fertilizer  **Subtotal**  **Wetland Restoration/Mitigation** Total cost to restore/mitigate wetlands  **Subtotal**  **Construction Monitoring Costs**  **Construction Oversight**  Oversight Engineers  Senior Chemist  **Project Engineer** Chief Engineer  Chief Engineer  Chief Engineer  **Subtotal**  **Analytical Testing - Onsite Field Screening (soil/sediment)  RapID ® PAH Test Kits (50 tests per kit)  RapID ® PAH Test Kits (50 tests per kit)  RapID ® PAH Est raction Kits (12 tests per kit)  RapID ® PAH Est raction Kits (12 tests per kit)  RapID ® PAH Est raction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  RapID ® PAH Estraction Kits (12 tests per kit)  Babiotal  **Analytical Testing - Offsite Lab for Confirmation Testing** PAHs (EPA Method 8270 SIM)  PCP (EPA Method 8270 SIM)	2.00  96  74  74  890  2.64  2.64  2.64  1.50  8  8  8  8  8  8  8  8  40  40  450  45	Acre  Ton LCY LCY SY  Acre Acre  Acre  Acre  HR HR HR HR HR LS  Kit Kit Kit Kit Kit Kit Kit Kit Kit Ki	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$16.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.85	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$6,290 \$4,400 \$50,400 \$74,250 \$66,488 \$509,700 \$33,300 \$495 \$3,800 \$1,311,800 \$328,000 \$98,400	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote  Vendor Quote
RESTORATION 3-Inch Habitat Mix Laver Within Creek Channel Habitat mix material, stockpiled onsite Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload Spread dumped material - by dozer, no compaction Finish grading slopes, gentle  Subtotal  Revegetation Seeding Fertilizer  Subtotal  Wetland Restoration/Mitigation Total cost to restore/mitigate wetlands  Subtotal  Wetsight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal  Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit) RapID ®	2.00  96  74  74  890  1.50  1.50  8  8  8  8  8  8  8  34  2  450  450  450  450  450  450  450	Acre  Ton LCY LCY SY  Acre Acre Acre  HR HR HR HR HR LS  Kit Kit Kit Kit Kit Kit Kit Kit Kit Ki	\$1.21 \$0.73 \$0.11 \$85.00 \$90.00 \$120.00	\$1.84 \$1.25	\$11.35 \$0.89 \$3.05 \$1.98 \$0.80 \$1,700 \$500 \$70,000 \$70,000 \$16.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.675 \$1.85	\$1,000 \$4,400 \$1,092 \$66 \$226 \$147 \$716 \$2,200 \$4,488 \$1,320 \$5,800 \$105,000 \$105,000 \$105,000 \$28,800 \$9,600 \$98,800 \$6,640 \$13,400 \$13,400 \$6,290 \$4,400 \$50,400 \$50,400 \$74,250 \$66,488 \$509,700 \$33,300 \$495 \$3,800 \$1,311,800 \$328,000 \$1,639,800	Vendor Quote  HCCD 31 23 23.15 6045  HCCD 31 23 23.20 1014  HCCD 31 23 23.17 0020  HCCD 31 22 16.10 3300  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Engineering Estimate  Vendor Quote

CONSTRUCTION TOTAL (TOTAL CAPITAL COST)

References:
R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).
EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance).

\$2,066,200

## Table D4. Cost Estimate for Alternative 3: Excavation, Consolidation, Capping, and Creek Reroute

### Assumptions:

- 1. Alternative 3:
  - Contaminated material will be excavated from the upper and lower reaches of the existing creek channel and the area downstream of the box culvert.
  - Material excavated to create the new upper creek channel is assumed to be clean, and will be used as backfill and cap material.
  - Excavated contaminated areas will be backfilled with clean material.
- Excavated contaminated material will be placed within the middle reach of the existing creek channel (repository area) prior to capping.
- The middle reach of the existing creek channel and the historical creek channel will be capped with a 0.5' layer of 4-inch minus rock (biotic barrier layer), overlain by a 2' layer of clean soil. Geotextile demarcation material will be placed below the biotic barrier layer, and geotextile filter fabric will be placed above the biotic barrier layer.
- The estuary area is assumed to be clean and will be used as the borrow area for additional cap material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Assume construction duration of 10 weeks.
- 3. Surveying:
  - Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
  - Surveying during construction: assume 2-man crew for 24 field days (2 days per week) and 2-man crew for 12 office days.
  - Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- 4. Total area to clear and grub (per AutoCAD) = existing creek channel removal action area + historical creek channel cap area + new upper creek channel excavation area + borrow area (estuary area)
  - = 25,102 SF + 54,261 SF + 26,629 SF + 1 acre = 149,552 SF (3.43 acres).
- 5. Clear and grub: assume 1 acre light trees to 6" diameter; remaining 2.43 acres light brush.
- 6. Total contaminated material excavation volume (per calculations) = existing creek channel (upper and lower reach) excavation volume + area downstream of box culvert excavation volume
- = 1,380 CY + 380 CY = 1,760 BCY (bank, in-place; to be placed within the middle reach of the existing creek channel).
- 7. Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 2,024 LCY (loose, excavated).
- 8. Total contaminated material excavation area (per AutoCAD) = existing creek channel (upper reach) excavation area + existing creek channel (lower reach) excavation area + area downstream of box culvert excavation area = 1.414 SF + 12,437 SF + 1,116 SF = 14,967 SF (1,663 SY).
- 9. Total contaminated material excavation perimeter (per AutoCAD) = existing creek channel (upper reach) excavation and area downstream of box culvert excavation perimeter + existing creek channel (lower reach) excavation perimeter = 365 ft + 1,615 ft = 1,980 ft.
- 10. New upper creek channel excavation volume (per calculations) = 3,025 BCY (to be used as backfill and cap material). Loose volume = 3,025 BCY x 1.15 = 3,479 LCY.
- 11. New upper creek channel excavation area (per AutoCAD) = 26,629 SF.
- 12. Borrow source (estuary area) excavation volume (per calculations) = 7,375 BCY (additional cap material needed). Loose volume = 7,375 BCY x 1.15 = 8,481 LCY.
- 13. Total cap area (per AutoCAD) = existing creek channel (middle reach) cap area + historical creek channel cap area = 10,135 SF + 54,261 SF = 64,396 SF (7,155 SY).
- 14. Assume the new upper creek channel will be excavated prior to excavation and capping of the existing creek channel; that way the creek can be diverted to the new channel to allow for excavation and capping in the upper existing creek channel.
- 15. Assume soil excavated from the new upper creek channel will be stockpiled onsite for use as backfill and cap material.
- 16. Assume a water diversion system will be in place during excavation of the lower reach of the existing creek channel: the system will consist of a pump behind an earthen dam at the upstream end of the excavation, from which water will be pumped through a hose to a settling pond at the downstream end of the excavation
- 17. Total backfill/cap soil material volume = 3,479 LCY + 8,481 LCY = 11,960 LCY.
- 18. Total backfill/cap area = 1,663 SY + 7,155 SY = 8,818 SY.
- 19. For capping of the middle reach of the existing creek channel and the historical creek channel, assume a 6-inch layer of 4-inch minus rock will be placed.
- Volume of 4-inch minus rock needed = 64,396 SF x (6/12) ft = 32,198 CF (1,193 CY).
- Assume 4-inch minus rock density = 1.4 tons/CY; therefore, 1,670 tons 4-inch minus rock needed.
- Assume 4-inch minus rock material imported and stockpiled at the LSC Site at a location to be determined.
- 20. For restoration of the existing creek channel (lower reach) and new upper creek channel, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed along the entire channel. For restoration of the existing creek channel (remaining backfilled/capped area), historical creek channel cap area, and estuary area, assume the entire area will be revegetated.
  - Habitat mix area (per AutoCAD, approx.) = 4,000 SF + 26,629 SF = 30,629 SF (3,403 SY).
  - Volume of habitat mix material needed = 30,629 SF x (3/12) ft = 7,657 CF (284 CY).
  - Assume habitat mix material density = 1.3 tons/CY; therefore, 370 tons habitat mix material needed.
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
  - Total area to be revegetated = (25,102 SF 4,000 SF) + 54,261 SF + 1 acre = 118,923 SF (2.73 acres).
- 21. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1 acre (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
  - Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- 22. For construction oversight and onsite analytical testing:
- Assume two oversight engineers (one for 40 hours per week, and one for 20 hours per week for 10 weeks); one chemist to perform onsite field screening (20 hours per week for 10 weeks); one project engineer (10 hours per week for 10 weeks); and one chief engineer (5 hours per week for 10 weeks).
- 23. Onsite field screening:
  - Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab.
- Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 14,967 SF/625 SF = 24 sample locations. Assume three samples per sample location = 72 samples. Assume 80 samples total.
- 24. Offsite lab analysis:
  - Contamination delineation confirmation samples (soil/sediment): 20% of 80 samples = 16 samples.
  - Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of excavation = 14,967 SF/625 SF = 24 samples. Assume 30 samples total. - Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 1,980 ft/25 ft = 79 samples. Assume 90 samples total.
- 25. Annual Post-Removal Site Control (PRSC) costs:
  - Calculated per EPA FS Guidance using the present value analysis method with a discount rate of 7% and a 30-year analysis period.

						UNIT		
Description	QTY	UNIT	LABOR	<b>EQUIP</b>	MTRL	TOTAL	TOTAL	Reference
GENERAL								
Plans and Submittals		T						
Construction Operations Plan, Quality Control Plan, and Safety Plan		LS					\$10,000	Engineering Estimate
Subtotal							\$10,000	
Pre-Construction Surveying							•	
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	3	Day	\$1,015.12			\$1,015.12	\$3,045	HCCD Crews
Subtotal							\$8,300	
Surveying During Construction			"				φο,εσσ	
HCCD Crew A-7, 2-man field	24	Day	\$1,015.12	\$80.97		\$1,096.08	\$26,300	HCCD Crews
HCCD Crew A-7, 2-man office	12	Day	\$1,015.12	7		\$1,015.12	\$12,181	HCCD Crews
Subtotal			7-,0			7-,0	\$38,500	
Post-Construction Surveying							φ50,500	
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 3-man note HCCD Crew A-7, 2-man office	5	Day	\$1,015.12	ψ00.71		\$1,015.12	\$5,076	HCCD Crews
		Day	Ψ1,013.12			Ψ1,013.12		Heed ciews
Subtotal							\$10,300	
Quality Control During Construction Quality Control (e.g., compaction testing)		LS					¢15 000	Englishment - Estimate
		LS					\$15,000	Engineering Estimate
Subtotal							\$15,000	
MOBILIZATION/DEMOBILIZATION	10		02.025			#2.02 <i>7</i>	#20.24S	VIGGD 04 44 40 00 00 00
Site Superintendent	10	WK	\$2,835			\$2,835	\$28,349	HCCD 01 31 13.20 0260
Clerk	10	WK	\$607			\$607	\$6,069	HCCD 01 31 13.20 0020
Project Manager	10	WK	\$3,074			\$3,074	\$30,744	HCCD 01 31 13.20 0200
Field Engineer	10	WK	\$1,861	p270		\$1,861	\$18,606	HCCD 01 31 13.20 0120
Trailers (incl air conditioning) - 2 Electric	6 10	MO WK		\$278		\$278 \$200	\$1,670 \$2,000	HCCD 01 52 13.20 0350 Engineering Estimate
Electric Install	2	EA				\$150	\$300	Engineering Estimate  Engineering Estimate
Telephone - 2 lines	20	WK				\$100	\$2,000	Engineering Estimate  Engineering Estimate
Portable Toilet - 2	6	MO		\$197.51		\$198	\$1,185	HCCD 01 54 33 40 6410
Field Office Expenses	6	MO		\$179.03		\$179	\$1,074	HCCD 01 54 33 40 0410
•	0	1410		ψ177.03		Ψ177		11000 01 32 13.40 0100
Subtotal							\$92,000	
EXCAVATION Clear and Grub								
Cut and chip light trees to 6" diameter	1.00	Acre	\$2,555.36	\$1,501.50		\$4,057	\$4,057	HCCD 31 11 10.10 0020
Grub stumps and remove	1.00	Acre	\$670.78	\$1,114.58		\$1,785	\$1,785	HCCD 31 11 10.10 0020
Clear light brush with dozer	2.43	Acre	\$466.35	\$623.70		\$1,783	\$2,649	HCCD 31 13 13.10 0300
ŭ .	4.43	ACIE	φ+00.33	φυΔ3.70		φ1,090	\$8,500	11000 31 13 13.10 0300
Subtotal	LEU/C 3/	[atawi-1					φο,300	
Excavation of New Upper Creek Channel and Stockpiling for Use as Back	кии/Сар М	ateriai	1				<u> </u>	
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	3,025	BCY	\$0.72	\$1.04		\$1.76	\$5,319	HCCD 31 23 16.42 0260
capacity For leading onto trucks, add 15%						+	\$798	HCCD 31 32 16 42 0020
For loading onto trucks, add 15%  Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.						+	Φ17 <b>0</b>	HCCD 31 23 16.42 0020
	3,479	LCY	\$1.21	\$1.84		\$3.05	\$10,611	HCCD 31 23 23.20 1014
wait/load/travel/unload								
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	3,479	LCY	\$0.54	\$0.35		\$0.89	\$3,094	HCCD 31 23 23.25 6045
1						+	¢10.000	
Subtotal   Excavation of Contaminated Areas and Placement Within Middle Reach							\$19,800	

Table D4 Cost Estimate for Alternative 2. Everyties, Consoli	dation Ca		d Crook D	amazita			
Table D4. Cost Estimate for Alternative 3: Excavation, Consoli Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	1,760	BCY	\$0.72	\$1.04	\$1.76	\$3,094	HCCD 31 23 16.42 0260
capacity For loading onto trucks, add 15%	1,700	BC I	\$0.72	\$1.04	\$1.76	\$464	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	2,024	LCY	\$1.21	\$1.84	\$3.05	\$6,174	HCCD 31 23 23.20 1014
wait/load/travel/unload Front end loader, wheel mounted, 3 CY bucket - for contaminated material	*						
management	2,024	LCY	\$0.54	\$0.35	\$0.89	\$1,800	HCCD 31 23 23.15 6045
Compaction - riding, vibrating roller, 6" lifts, 2 passes	2,024	LCY	\$0.24	\$0.18	\$0.42	\$859 \$12,400	HCCD 31 23 23.23 5000
Subtotal Diversion of Water During Excavation of the Lower Reach of the Existi	ng Creek Cl	nannel				φ12,400	
4" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction hose and 100 LF discharge hose	10	Day	\$182.07	\$27.14	\$209.21	\$2,092	HCCD 31 23 19.20 0650
Subtotal						\$2,100	
Excavation from Borrow Area (Estuary Area) (loading, hauling and pla	cement incl	uded in fol	lowing secti	on)			
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY capacity	7,375	BCY	\$0.72	\$1.04	\$1.76	\$12,967	HCCD 31 23 16.42 0260
Subtotal						\$13,000	
Backfill of Excavated Contaminated Areas (Upper and Lower Reaches of Creek Channel and Historical Creek Channel)	of Existing C	Creek Chai	nnel and Ar	ea Downstre	am of Box Culvert) and	Clean Soil Plac	ement for Cap (Middle Reach of Existing
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto	11,960	LCY	\$0.54	\$0.35	\$0.89	\$10,639	HCCD 31 23 23.15 6045
dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	11,700		Ψ0.54			Ψ10,037	11000 31 23 23.13 0043
wait/load/travel/unload	11,960	LCY	\$1.21	\$1.84	\$3.05	\$36,481	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction Finish grading slopes, gentle	11,960 8,818	LCY SY	\$0.73 \$0.11	\$1.25 \$0.69	\$1.98 \$0.80	\$23,706 \$7,097	HCCD 31 23 23.17 0020 HCCD 31 22 16.10 3300
Compaction - riding, vibrating roller, 6" lifts, 2 passes	11,960	LCY	\$0.11	\$0.09	\$0.42	\$5,075	HCCD 31 23 23.23 5000
Subtotal						\$83,000	
CAPPING (Note: soil placement is included in preceding section) Geotextile demarcation material - for placement between contaminated	7155	037			#C 22	#0.71¢	V 1 0
material and biotic barrier layer  Geotextile filter fabric - for placement between biotic barrier layer and clean	7,155	SY			\$0.38	\$2,719	Vendor Quote
soil	7,155	SY			\$0.58	\$4,114	Vendor Quote
Subtotal						\$6,800	
6-Inch Biotic Barrier Layer 4-inch minus rock, stockpiled onsite	1,670	Ton			\$7.85	\$13,111	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto	1,193	CY	\$0.54	\$0.35	\$0.89	\$1,061	HCCD 31 23 23.15 6045
dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.				-			
wait/load/travel/unload	1,193	CY	\$1.21	\$1.84	\$3.05	\$3,639	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction Finish grading slopes, gentle	1,193 7,155	CY SY	\$0.73 \$0.11	\$1.25 \$0.69	\$1.98 \$0.80	\$2,365 \$5,758	HCCD 31 23 23.17 0020 HCCD 31 22 16.10 3300
Subtotal						\$25,900	
RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel							
Habitat mix material, stockpiled onsite	369	Ton			\$11.35	\$4,190	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto dump truck	284	CY	\$0.54	\$0.35	\$0.89	\$253	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	284	CY	\$1.21	\$1.84	\$3.05	\$866	HCCD 31 23 23.20 1014
wait/load/travel/unload Spread dumped material - by dozer, no compaction	284	CY	\$0.73	\$1.25	\$1.98	\$563	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	3,403	SY	\$0.11	\$0.69	\$0.80	\$2,739	HCCD 31 22 16.10 3300
Subtotal Revegetation						\$8,600	
Seeding	2.73	Acre			\$1,700	\$4,641	Vendor Quote
Fertilizer	2.73	Acre			\$500	\$1,365	Vendor Quote
Subtotal Wetland Restoration/Mitigation						\$6,000	
Total cost to restore/mitigate wetlands	1.50	Acre			\$70,000	\$105,000	Engineering Estimate
Subtotal CONSTRUCTION MONITORING						\$105,000	
Construction Oversight	600	IID	<b>#97.00</b>			Ф51 000	B B
Oversight Engineers Senior Chemist	600 200	HR HR	\$85.00 \$90.00			\$51,000 \$18,000	Engineering Estimate Engineering Estimate
Project Engineer	100	HR	\$120.00			\$12,000	Engineering Estimate
Chief Engineer Subtotal	50	HR	\$150.00			\$7,500 \$88,500	Engineering Estimate
Analytical Testing - Onsite Field Screening (soil/sediment)							
RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit)	2 2	Kit Kit			\$830 \$1,675	\$1,660 \$3,350	Vendor Quote  Vendor Quote
RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)	2	Kit			\$1,675	\$3,350	Vendor Quote
RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for	6	Kit			\$185	\$1,110	Vendor Quote
cPAHs) Rental: SDI RaPID ® Accessory Kit	6	Kit			\$185	\$1,110	Vendor Quote
Rental: SDI RaPID ® Accessory Kit  Subtotal	2	МО			\$2,200	\$4,400 \$15,000	Vendor Quote
Analytical Testing - Offsite Lab for Confirmation Testing		<b>-</b>		1			· · · · -
PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151)	136 136	Test Test			\$165 \$145	\$22,440 \$19,720	Vendor Quote  Vendor Quote
Dioxin/Furans (EPA Method 8290)	136	Test			\$675	\$91,800	Vendor Quote
Deliverables (EDD and Hardcopy)  Subtotal		LS				\$20,094 \$154,100	Vendor Quote
CONSTRUCTION SUBTOTAL						\$722,800	
CONSTRUCTION SUBTOTAL	25	%				\$180,700 <b>\$903,500</b>	EPA FS Guidance
Construction Contingency			1			\$ <b>903,500</b> \$ <b>54,300</b>	ED + EG G : I
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management	6	%					EPA FS Guidance
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management Removal Action Design	6 12	%				\$108,500	EPA FS Guidance
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management	6	+					
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)	6 12	%				\$108,500 \$72,300	EPA FS Guidance
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)  ANNUAL POST REMOVAL SITE CONTROL (PRSC)	6 12 8	%			\$400	\$108,500 \$72,300 <b>\$235,100</b> <b>\$1,138,600</b>	EPA FS Guidance EPA FS Guidance
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)	6 12 8	%			\$400	\$108,500 \$72,300 \$235,100 \$1,138,600 \$7,338 \$7,400	EPA FS Guidance EPA FS Guidance  Engineering Estimate
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)  ANNUAL POST REMOVAL SITE CONTROL (PRSC)  Maintenance of repository/cap for 30 years  ANNUAL PRSC SUBTOTAL  Annual PRSC Contingency	6 12 8	%			\$400	\$108,500 \$72,300 \$235,100 \$1,138,600 \$7,338 \$7,400 \$1,900	EPA FS Guidance EPA FS Guidance
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)  ANNUAL POST REMOVAL SITE CONTROL (PRSC)  Maintenance of repository/cap for 30 years  ANNUAL PRSC SUBTOTAL	1.48 25	% % Acre			\$400	\$108,500 \$72,300 \$235,100 \$1,138,600 \$7,338 \$7,400 \$1,900 \$9,300 \$800	EPA FS Guidance EPA FS Guidance  Engineering Estimate
Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)  ANNUAL POST REMOVAL SITE CONTROL (PRSC)  Maintenance of repository/cap for 30 years  ANNUAL PRSC SUBTOTAL  Annual PRSC Contingency SUBTOTAL W/CONTINGENCY	1.48 25	% % Acre			\$400	\$108,500 \$72,300 \$235,100 \$1,138,600 \$7,338 \$7,400 \$1,900 \$9,300	EPA FS Guidance EPA FS Guidance  Engineering Estimate  EPA FS Guidance

TOTAL FOR CONSTRUCTION AND ANNUAL PRSC

References:

R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance).

\$1,150,100

## Table D5. Cost Estimate for Alternative 4: Excavation, Consolidation, Capping, and Creek Reroute back through the Historical Creek Channel

## Assumptions:

- 1. Alternative 4:
  - Contaminated material will be excavated from the upper and lower reaches of the existing creek channel and the area downstream of the box culvert.
  - Material excavated to create the new upper creek channel is assumed to be clean (from Station 100+00 E to 103+00 E), and will be used as backfill and cap material.
  - Excavated contaminated areas will be backfilled with clean material.
  - Excavated contaminated material will be placed within the middle reach of the existing creek channel (repository area) prior to capping.
- The middle reach of the existing creek channel and the historical creek channel will be capped with a 0.5' layer of 4-inch minus rock (biotic barrier layer), overlain by a 2' layer of clean soil. Geotextile demarcation material will be placed below the biotic barrier layer, and geotextile filter fabric will be placed above the biotic barrier layer.
- The estuary area is assumed to be clean and will be used as the borrow area for additional cap material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Assume construction duration of 10 weeks.
- Surveying:
  - Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
  - Surveying during construction: assume 2-man crew for 24 field days (2 days per week) and 2-man crew for 12 office days.
  - Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- 4. Total area to clear and grub (per AutoCAD) = existing creek channel (upper reach) excavation area + existing creek channel (lower reach) excavation area + area downstream of box culvert excavation area + existing creek channel (middle reach) cap area + historical creek channel removal action area + new upper creek channel excavation area (clean portion) + borrow area (estuary area) = 1,414 SF + 12,437 SF + 1,116 SF + 22,906 SF + 54,261 SF + 11,845 SF + 1 acre = 147,539 SF (3.39 acres).
- Clear and grub: assume 1 acre light trees to 6" diameter; remaining 2.39 acres light brush.

6. Total contaminated material excavation volume (per calculations) = existing creek channel (upper and lower reach) excavation volume + area downstream of box culvert excavation volume + historical creek channel (lower reach) excavation volume + new upper creek channel excavation volume (extra volume excavated for channel below delineated contamination) = 1,380 CY + 380 CY + 2,593 CY + 919 CY = 5,272 BCY (bank, in-place; to be placed within the middle reach of the existing creek channel).

- 7. Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 6,063 LCY (loose, excavated).
- 8. Total contaminated material excavation area (per AutoCAD) = existing creek channel (upper reach) excavation area + existing creek channel (lower reach) excavation area + area downstream of box culvert excavation area + historical creek channel excavation area = 1,414 SF + 12,437 SF + 1,116 SF + 33,916 SF = 48,883 SF (5,431 SY).
- 9. Total contaminated material excavation perimeter (per AutoCAD) = existing creek channel (upper reach) excavation and area downstream of box culvert excavation perimeter + historical creek channel (lower reach) and existing creek channel (lower reach) excavation perimeter = 365 ft + 3,229 ft = 3,594 ft.
- 10. New upper creek channel excavation volume (clean portion; per calculations) = 1,471 BCY (to be used as backfill and cap material). Loose volume = 1,471 BCY x 1.15 = 1,692 LCY.
- 11. New upper creek channel excavation area (clean portion; per AutoCAD) = 11,845 SF.
- 12. Borrow source (estuary area) excavation volume (per calculations) = 7,264 BCY (additional cap material needed). Loose volume = 7,264 BCY x 1.15 = 8,354 LCY.
- 13. Total cap area (per AutoCAD) = existing creek channel (middle reach) cap area + historical creek channel cap area = 22,906 SF + 19,928 SF = 42,834 SF (4,759 SY).
- 14. Assume the new upper creek channel will be excavated prior to excavation and capping of the existing creek channel; that way the creek can be diverted to the new channel to allow for excavation and capping in the upper existing creek
- 15. Assume soil excavated from the new upper creek channel (clean portion) will be stockpiled onsite for use as backfill and cap material.
- 16. Assume a water diversion system will be in place during excavation of the lower reach of the existing creek channel: the system will consist of a pump behind an earthen dam at the upstream end of the excavation, from which water will be pumped through a hose to a settling pond at the downstream end of the excavation
- 17. Total backfill/cap soil material volume = 1,692 LCY + 8,354 LCY = 10,046 LCY.
- 18. Total backfill/cap area = 5,431 SY + 4,759 SY = 10,190 SY.
- 19. For capping of the middle reach of the existing creek channel and the historical creek channel, assume a 6-inch layer of 4-inch minus rock will be placed.
  - Volume of 4-inch minus rock needed = 42,834 SF x (6/12) ft = 21,417 CF (794 CY).
  - Assume 4-inch minus rock density = 1.4 tons/CY; therefore, 1,112 tons 4-inch minus rock needed.
- Assume 4-inch minus rock material imported and stockpiled at the LSC Site at a location to be determined.
- 20. For restoration of the existing creek channel (lower reach) and new upper creek channel, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed along the entire channel. For restoration of the existing creek channel (remaining backfilled/capped area), historical creek channel cap area, and estuary area, assume the entire area will be revegetated.
  - Habitat mix area (per AutoCAD, approx.) = 4,000 SF + 35,856 SF = 39,856 SF (4,428 SY).
  - Volume of habitat mix material needed = 39,856 SF x (3/12) ft = 9,964 CF (369 CY).
  - Assume habitat mix material density = 1.3 tons/CY; therefore, 480 tons habitat mix material needed.
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
- $Total\ area\ to\ be\ revegetated = 1,414\ SF + (12,437\ SF 4,000\ SF) + 1,116\ SF + 22,906\ SF + 1\ acre = 97,361\ SF\ (2.24\ acres).$
- 21. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1 acre (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
  - Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- 22. For construction oversight and onsite analytical testing:
- Assume two oversight engineers (one for 40 hours per week, and one for 20 hours per week for 10 weeks); one chemist to perform onsite field screening (20 hours per week for 10 weeks); one project engineer (10 hours per week for 10 weeks); and one chief engineer (5 hours per week for 10 weeks).
- 23. Onsite field screening:
  - Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab.
- Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 48,883 SF/625 SF = 78 sample locations. Assume three samples per sample location = 234 samples. Assume 250 samples total.
- 24. Offsite lab analysis:
  - Contamination delineation confirmation samples (soil/sediment): 20% of 250 samples = 50 samples.
  - Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of excavation = 48,883 SF/625 SF = 78 samples. Assume 90 samples total.
- Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 3,594 ft/25 ft = 144 samples. Assume 160 samples total. Annual Post-Removal Site Control (PRSC) costs.
  - Calculated per EPA FS Guidance using the present value analysis method with a discount rate of 7% and a 30-year analysis period.

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	OTTE		LAROR	FOLUD	MEDI	UNIT	mom . r	D 6
Description   GENERAL	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	TOTAL	Reference
Plans and Submittals								
Construction Operations Plan, Quality Control Plan, and Safety Plan		LS					\$10,000	Englishming Estimate
		LS						Engineering Estimate
Subtotal							\$10,000	
Pre-Construction Surveying			1					1
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	3	Day	\$1,015.12			\$1,015.12	\$3,045	HCCD Crews
Subtotal							\$8,300	
Surveying During Construction								
HCCD Crew A-7, 2-man field	24	Day	\$1,015.12	\$80.97		\$1,096.08	\$26,300	HCCD Crews
HCCD Crew A-7, 2-man office	12	Day	\$1,015.12			\$1,015.12	\$12,181	HCCD Crews
Subtotal							\$38,500	
Post-Construction Surveying		1	1				φ50,500	1
HCCD Crew A-7, 3-man field	3	Dav	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 3-man fried HCCD Crew A-7, 2-man office	5	Day	\$1,030.31	ψO0.71		\$1,015.12	\$5,076	HCCD Crews
		Day	ψ1,013.12			ψ1,013.12		TICCD CICWS
Subtotal							\$10,300	
Quality Control During Construction		1.0	1				¢15.000	
Quality Control (e.g., compaction testing)		LS					\$15,000	Engineering Estimate
Subtotal							\$15,000	
MOBILIZATION/DEMOBILIZATION								
Site Superintendent	10	WK	\$2,835			\$2,835	\$28,349	HCCD 01 31 13.20 0260
Clerk	10	WK	\$607			\$607	\$6,069	HCCD 01 31 13.20 0020
Project Manager	10	WK	\$3,074			\$3,074	\$30,744	HCCD 01 31 13.20 0200
Field Engineer	10	WK	\$1,861			\$1,861	\$18,606	HCCD 01 31 13.20 0120
Trailers (incl air conditioning) - 2	6	MO		\$278		\$278	\$1,670	HCCD 01 52 13.20 0350
Electric	10	WK				\$200	\$2,000	Engineering Estimate
Electric Install	2	EA				\$150	\$300	Engineering Estimate
Telephone - 2 lines	20	WK				\$100	\$2,000	Engineering Estimate
Portable Toilet - 2	6	MO		\$197.51		\$198	\$1,185	HCCD 01 54 33 40 6410
Field Office Expenses	6	MO		\$179.03		\$179	\$1,074	HCCD 01 52 13.40 0100
Subtotal							\$92,000	
EXCAVATION		1					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Clear and Grub								
Cut and chip light trees to 6" diameter	1.00	Acre	\$2,555.36	\$1,501.50		\$4,057	\$4,057	HCCD 31 11 10.10 0020
Grub stumps and remove	1.00	Acre	\$670.78	\$1,114.58		\$1,785	\$1,785	HCCD 31 11 10.10 0150
Clear light brush with dozer	2.39	Acre	\$466.35	\$623.70		\$1,090	\$2,605	HCCD 31 13 13.10 0300
Subtotal							\$8,400	
Subtotal   Excavation of New Upper Creek Channel (Clean Portion) and Stockpilin	a for Use o	s Rackfill/	Can Materie	.l			φυ,του	1
Excavation of New Opper Creek Channel (Clean Portion) and Stockpliin  Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	g for Use a	5 Dackill	Cap Materia	11				
capacity	1,471	BCY	\$0.72	\$1.04		\$1.76	\$2,586	HCCD 31 23 16.42 0260
For loading onto trucks, add 15%							\$388	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.						+ +		
wait/load/travel/unload	1,692	LCY	\$1.21	\$1.84		\$3.05	\$5,160	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	1,692	LCY	\$0.54	\$0.35		\$0.89	\$1,505	HCCD 31 23 23.25 6045

G 1 1	dation, Cap	ping, and	d Creek R	eroute back	through the mistories	11 Creek Chai \$9,600	nnel
Subtotal   Excavation of Contaminated Areas and Placement Within Middle Reach	of Existing	Creek Ch	annel (Ren	ository)		\$9,000	
Excavation of Contaminated Areas and Flacement within Middle React Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	5,272	BCY	\$0.72	\$1.04	\$1.76	\$9,269	HCCD 31 23 16.42 0260
capacity	3,212	BC I	\$0.72	\$1.04	\$1.76		
For loading onto trucks, add 15% Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.						\$1,390	HCCD 31 23 16.42 0020
wait/load/travel/unload	6,063	LCY	\$1.21	\$1.84	\$3.05	\$18,493	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for contaminated material	6,063	LCY	\$0.54	\$0.35	\$0.89	\$5,393	HCCD 31 23 23.15 6045
nanagement Compaction - riding, vibrating roller, 6" lifts, 2 passes	6,063	LCY	\$0.24	\$0.18	\$0.42	\$2,573	HCCD 31 23 23.23 5000
Subtotal	0,003	LCI	\$0.24	\$0.18	\$0.42	\$37,100	HCCD 31 23 23.23 3000
Diversion of Water During Excavation of the Lower Reach of the Existin	ng Creek Ch	annel				φ57,100	
" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction	10	Day	\$182.07	\$27.14	\$209.21	\$2,092	HCCD 31 23 19.20 0650
nose and 100 LF discharge hose		Day	Ψ102.07	Ψ27.14	Ψ207.21		11005 31 23 17.20 0030
Subtotal   Excavation from Borrow Area (Estuary Area) (loading, hauling and pla	coment inclu	dod in fol	lowing socti	ion)		\$2,100	
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY			Ŭ		<b>*4.5</b>	040.550	77.00 01.00 1.010 00.00
capacity	7,264	BCY	\$0.72	\$1.04	\$1.76	\$12,772	HCCD 31 23 16.42 0260
Subtotal						\$12,800	
Backfill of Excavated Contaminated Areas (Upper and Lower Reaches of Creek Channel and Historical Creek Channel)	of Existing Co	reek Char	nnel and Ar	rea Downstrea	am of Box Culvert) and	Clean Soil Plac	ement for Cap (Middle Reach of Existing
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto							
lump truck	10,045	LCY	\$0.54	\$0.35	\$0.89	\$8,935	HCCD 31 23 23.15 6045
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min.	10,045	LCY	\$1.21	\$1.84	\$3.05	\$30,640	HCCD 31 23 23.20 1014
vait/load/travel/unload Spread dumped material - by dozer, no compaction	10,045	LCY	\$0.73	\$1.25	\$1.98	\$19,910	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	10,191	SY	\$0.73	\$0.69	\$0.80	\$8,202	HCCD 31 22 16.10 3300
Compaction - riding, vibrating roller, 6" lifts, 2 passes	10,045	LCY	\$0.24	\$0.18	\$0.42	\$4,263	HCCD 31 23 23.23 5000
Subtotal						\$72,000	
CAPPING (Note: soil placement is included in preceding section)  Geotextile demarcation material - for placement between contaminated							
naterial and biotic barrier layer	4,759	SY			\$0.38	\$1,808	Vendor Quote
Geotextile filter fabric - for placement between biotic barrier layer and clean	4,759	SY			\$0.58	\$2,736	Vendor Quote
soil	<del>-1</del> ,137	31			φυ.36		vendor Quote
Subtotal Subtotal						\$4,500	1
6-Inch Biotic Barrier Layer I-inch minus rock, stockpiled onsite	1,112	Ton			\$7.85	\$8,726	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto	794	CY	\$0.54	\$0.35	\$0.89	\$706	HCCD 31 23 23.15 6045
lump truck	794	CI	\$0.54	\$0.55	\$0.09	\$700	HCCD 31 23 23.13 0043
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	794	CY	\$1.21	\$1.84	\$3.05	\$2,422	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction	794	CY	\$0.73	\$1.25	\$1.98	\$1,574	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	4,759	SY	\$0.11	\$0.69	\$0.80	\$3,830	HCCD 31 22 16.10 3300
Subtotal						\$17,300	
RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel							
Habitat mix material, stockpiled onsite	480	Ton			\$11.35	\$5,445	Vendor Quote
Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto	369	CY	\$0.54	\$0.35	\$0.89	\$328	HCCD 31 23 23.15 6045
lump truck			ψ0.54	ψ0.55	ψ0.67	Ψ320	TICCD 31 23 23.13 0043
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	369	CY	\$1.21	\$1.84	\$3.05	\$1,126	HCCD 31 23 23.20 1014
Spread dumped material - by dozer, no compaction	369	CY	\$0.73	\$1.25	\$1.98	\$731	HCCD 31 23 23.17 0020
Finish grading slopes, gentle	4,428	SY	\$0.11	\$0.69	\$0.80	\$3,564	HCCD 31 22 16.10 3300
Subtotal						\$11,200	
Revegetation Seeding	2.24	Acre			\$1,700	\$3,808	Vendor Quote
Fertilizer	2.24	Acre			\$500	\$1,120	Vendor Quote
Subtotal						\$4,900	
Wetland Restoration/Mitigation		T .	ı				
Total cost to restore/mitigate wetlands	1.50	Acre			\$70,000	\$105,000	Engineering Estimate
Subtotal CONSTRUCTION MONITORING						\$105,000	
							•
onstruction Oversight							
Oversight Engineers	600	HR	\$85.00			\$51,000	Engineering Estimate
Oversight Engineers Senior Chemist	200	HR	\$90.00			\$18,000	Engineering Estimate
Oversight Engineers Senior Chemist Project Engineer	200 100	HR HR	\$90.00 \$120.00			\$18,000 \$12,000	Engineering Estimate Engineering Estimate
Senior Chemist Project Engineer Chief Engineer	200	HR	\$90.00			\$18,000 \$12,000 \$7,500	Engineering Estimate
Oversight Engineers Senior Chemist Project Engineer Chief Engineer Subtotal	200 100	HR HR	\$90.00 \$120.00			\$18,000 \$12,000	Engineering Estimate Engineering Estimate
Oversight Engineers Senior Chemist Project Engineer Chief Engineer Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit)	200 100 50	HR HR HR	\$90.00 \$120.00		\$830	\$18,000 \$12,000 \$7,500 \$88,500	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit)	200 100 50 5 5	HR HR HR Kit	\$90.00 \$120.00		\$1,675	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit)	200 100 50	HR HR HR	\$90.00 \$120.00			\$18,000 \$12,000 \$7,500 \$88,500	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit)	200 100 50 5 5 5 5 5 21	HR HR HR Kit Kit Kit Kit	\$90.00 \$120.00		\$1,675 \$1,675 \$185	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs)	200 100 50 5 5 5 5 5 21 21	HR HR HR Kit Kit Kit Kit Kit	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) Rental: SDI RaPID ® Accessory Kit	200 100 50 5 5 5 5 5 21	HR HR HR Kit Kit Kit Kit	\$90.00 \$120.00		\$1,675 \$1,675 \$185	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal	200 100 50 5 5 5 5 5 21 21	HR HR HR Kit Kit Kit Kit Kit	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RapID ® PCP Test Kits (50 tests per kit) RapID ® PAH Test Kits (50 tests per kit) RapID ® Carcinogenic PAH Test Kits (50 tests per kit) RapID ® PCP Extraction Kits (12 tests per kit) RapID ® PCP Extraction Kits (12 tests per kit) RapID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) Rental: SDI RapID ® Accessory Kit Subtotal Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM)	200 100 50 50 5 5 5 5 21 21 2	HR HR HR Kit Kit Kit Kit Kit Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Challe & PCP Test Kits (50 tests per kit)  Challe & PAH Test Kits (50 tests per kit)  Challe & Carcinogenic PAH Test Kits (50 tests per kit)  Challe & PCP Extraction Kits (12 tests per kit)  Challe & PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs)  Challe & Carcinogenic PAH Chief Engineer  Subtotal  Challet & Testing - Offsite Lab for Confirmation Testing  Challet & Carcinogenic PAH Confirmation Testing  Challet & Carcinogenic PAH Chief Engineer  Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Chief Engineer  Subtotal  Challet & Carcinogenic PAH Chief Engineer  Subtotal  Chief Engineer	200 100 50 50 5 5 5 5 21 21 2 2	HR HR HR Kit Kit Kit Kit Kit Test Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal  Challe B PCP Test Kits (50 tests per kit)  Challe B PAH Test Kits (50 tests per kit)  Challe B PAH Test Kits (50 tests per kit)  Challe B PCP Extraction Kits (12 tests per kit)  Challe B PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs)  Challe S DI RaPID & Accessory Kit  Subtotal  Challet Testing - Offsite Lab for Confirmation Testing  Challet C PA Method 8270 SIM)  CPC (EPA Method 8151)  Dioxin/Furans (EPA Method 8290)	200 100 50 50 5 5 5 5 21 21 2	HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal ChapID ® PCP Test Kits (50 tests per kit) ChapID ® PAH Test Kits (50 tests per kit) ChapID ® PCP Extraction Fits (12 tests per kit) ChapID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) ChapID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) ChapID ® Accessory Kit  Subtotal ChapIt Call Testing - Offsite Lab for Confirmation Testing ChapIt Call Testing - Offsite Lab for Call Testing - Offsi	200 100 50 50 5 5 5 5 21 21 2 2	HR HR HR Kit Kit Kit Kit Kit Test Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal Challe B PCP Test Kits (50 tests per kit) Challe B PCP Est Kits (50 tests per kit) Challe B PCP Extraction Kits (12 tests per kit) Challe B PCP Extraction Kits (12 tests per kit) Challe B PCP Extraction Kits (12 tests per kit; same extraction kit for PAHs) Challe Challe B PCP Extraction Kits (12 tests per kit; same extraction kit for PAHs) Challe Challe Challe B PCP Extraction Kits (12 tests per kit; same extraction kit for PAHs) Challe Chal	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300	HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500 \$44,325 \$339,800 \$920,400	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote  Vendor Quote Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Oversight Engineers  enior Chemist  troject Engineer  Chief Engineer  Subtotal  Construction Contingency  Subtotal  CONSTRUCTION SUBTOTAL  Construction Contingency	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300	HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote  Vendor Quote Vendor Quote Vendor Quote Vendor Quote
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Subtotal Challed Servering (soil/sediment) Challed Servering (s	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300	HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test LS	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  EPA FS Guidance
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Subtotal Challed September (Soil/sediment) Chief Engineer  Subtotal Challed September (Soil/sediment) Construction Contingency Subtotal Construction Contingency Sub	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300	HR HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test LS %	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$69,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  EPA FS Guidance
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Chief Engineer  Chief Engineer  Chief Engineer  Subtotal Chall © PCP Test Kits (50 tests per kit) Chall © PAH Test Kits (50 tests per kit) Chall © PCP Extraction Kits (12 tests per kit) Chall © PCP Extraction Kits (12 tests per kit; same extraction kit for PAHs) Chall © SDI RaPID © Accessory Kit  Subtotal Chall Testing - Offsite Lab for Confirmation Testing Chals (EPA Method 8270 SIM) CP (EPA Method 8151) Choxin/Furans (EPA Method 8290) Cheliverables (EDD and Hardcopy)  Subtotal CONSTRUCTION SUBTOTAL Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management Removal Action Design Construction Management	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300 300	HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test LS	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$44,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$138,100 \$92,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  EPA FS Guidance
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Oversight Engineers  enior Chemist  troject Engineer  Chief Engineer  Subtotal  Charling PCP Test Kits (50 tests per kit)  CapID ® PCP Test Kits (50 tests per kit)  CapID ® PCP Extraction Kits (12 tests per kit)  CapID ® PCP Extraction Kits (12 tests per kit)  CapID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs)  Cental: SDI RaPID ® Accessory Kit  Subtotal  Charling PCP Extraction Confirmation Testing  Charling PCP (EPA Method 8270 SIM)  CP (EPA Method 8151)  Choixin/Furans (EPA Method 8290)  Celiverables (EDD and Hardcopy)  Subtotal  CONSTRUCTION SUBTOTAL  Construction Contingency  SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST)  Project Management  Removal Action Design  Construction Management  SUBTOTAL (INDIRECT CAPITAL COST)  CONSTRUCTION TOTAL (TOTAL CAPITAL COST)	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300 300	HR HR HR HR HR  Kit Kit Kit Kit Kit Test Test Test LS  %	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$2,200 \$165 \$145	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$44,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$138,100 \$92,100	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  EPA FS Guidance  EPA FS Guidance  EPA FS Guidance
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Chalytical Testing - Onsite Field Screening (soil/sediment) CapID ® PCP Test Kits (50 tests per kit) CapID ® PAH Test Kits (50 tests per kit) CapID ® PCP Extraction Kits (12 tests per kit) CapID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) Cental: SDI RaPID ® Accessory Kit  Subtotal Chalytical Testing - Offsite Lab for Confirmation Testing Chals (EPA Method 8270 SIM) CPC (EPA Method 8151) Cioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal CONSTRUCTION SUBTOTAL Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST) CONSTRUCTION TOTAL (TOTAL CAPITAL COST) ANNUAL POST REMOVAL SITE CONTROL (PRSC)	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300 300	HR HR HR HR HR HR  Kit Kit Kit Kit Kit Kit Kit  MO  Test Test Test LS  % % % %	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$185 \$2,200 \$165 \$145 \$675	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$44,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$69,100 \$138,100 \$299,300 \$1,449,800	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  EPA FS Guidance EPA FS Guidance EPA FS Guidance EPA FS Guidance
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Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tes	200 100 50 50 5 5 5 5 21 21 2 2 300 300 300 300 300 300	HR HR HR HR HR  Kit Kit Kit Kit Kit Kit Kit  MO  Test Test Test LS  % % % % % % % % Acre	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$185 \$2,200 \$165 \$145 \$675	\$18,000 \$12,000 \$7,500 \$88,500 \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100 \$49,500 \$43,500 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$69,100 \$138,100 \$92,100 \$299,300 \$1,449,800	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  Vendor Quote  Engineering Estimate  EPA FS Guidance
Oversight Engineers Senior Chemist Project Engineer Chief Engineer Chief Engineer  Subtotal Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) RaPID ® PAH Test Kits (50 tests per kit) RaPID ® PCP Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit) RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for PAHs) Rental: SDI RaPID ® Accessory Kit  Subtotal Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Deliverables (EDD and Hardcopy)  Subtotal  CONSTRUCTION SUBTOTAL Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management SUBTOTAL (INDIRECT CAPITAL COST) CONSTRUCTION TOTAL (TOTAL CAPITAL COST) ANNUAL POST REMOVAL SITE CONTROL (PRSC) Maintenance of repository/cap for 30 years  ANNUAL PRSC SUBTOTAL Annual PRSC Contingency SUBTOTAL W/CONTINGENCY Project Management	200 100 50 5 5 5 5 5 21 21 2 300 300 300 300 300 300 300	HR HR HR HR HR HR  Kit Kit Kit Kit Kit Kit Kit  MO  Test Test Test LS  %  %  %  %  %  %  %  %  Acre	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$185 \$2,200 \$165 \$145 \$675	\$18,000 \$12,000 \$7,500 \$88,500  \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$4,400 \$33,100  \$49,500 \$44,350 \$202,500 \$44,325 \$339,800 \$920,400 \$230,100 \$1,150,500 \$69,100 \$138,100 \$92,100 \$1,449,800  \$1,449,800 \$1,300 \$5,200 \$5,500	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  Engineering Estimate  EPA FS Guidance
Oversight Engineers Senior Chemist Project Engineer Chief Engineer  Subtotal Charl © PCP Test Kits (50 tests per kit) Charl © PAH Test Kits (50 tests per kit) Charl © PAH Test Kits (50 tests per kit) Charl © PCP Extraction Kits (12 tests per kit) Charl © PCP Extraction Kits (12 tests per kit; same extraction kit for PAHs) Charl © Spah Extraction Kits (12 tests per kit; same extraction kit for PAHs) Charl © Spah Extraction Chief Charles Charl © Subtotal Charlytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) PCP (EPA Method 8270 SIM) PCP (EPA Method 8151) Dioxin/Furans (EPA Method 8290) Celiverables (EDD and Hardcopy)  Subtotal CONSTRUCTION SUBTOTAL Construction Contingency SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) Project Management Removal Action Design Construction Management SUBTOTAL (INDIRECT CAPITAL COST) CONSTRUCTION TOTAL (TOTAL CAPITAL COST) CONSTRUCTION TOTAL (TOTAL CAPITAL COST) ANNUAL POST REMOVAL SITE CONTROL (PRSC) Chaintenance of repository/cap for 30 years  ANNUAL PRSC SUBTOTAL Annual PRSC Contingency SUBTOTAL W/CONTINGENCY	200 100 50 5 5 5 5 5 21 21 2 300 300 300 300 300 300 300	HR HR HR HR HR HR  Kit Kit Kit Kit Kit Kit Kit  MO  Test Test LS  % % % % % % % % % % % % % % % % % %	\$90.00 \$120.00		\$1,675 \$1,675 \$185 \$185 \$185 \$2,200 \$165 \$145 \$675	\$18,000 \$12,000 \$7,500 \$88,500  \$4,150 \$8,375 \$8,375 \$3,885 \$3,885 \$3,885 \$4,400 \$33,100  \$49,500 \$44,325 \$339,800 \$202,500 \$44,325 \$339,800 \$21,100 \$1,150,500 \$69,100 \$138,100 \$92,100 \$1,449,800  \$1,300 \$44,881 \$4,900 \$1,300 \$6,200	Engineering Estimate Engineering Estimate Engineering Estimate  Vendor Quote  Vendor Quote  Engineering Estimate  EPA FS Guidance

References:

R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance).

## Table D6. Cost Estimate for Alternative 5: Excavation, Consolidation, Capping, and Long Creek Reroute back through the Historical Creek Channel

## Assumptions:

- Alternative 5:
  - Contaminated material will be excavated from the upper, middle and lower reaches of the existing creek channel, the historical creek channel, and the area downstream of the box culvert.
  - Material excavated to create the new creek channel is assumed to be clean (from Station 200+00 F to 212+00 F, and 221+50 F to 227+00 F), and will be used as backfill and cap material.
  - Excavated contaminated areas will be backfilled with clean material.
- Excavated contaminated material will be placed within the middle reach of the existing creek channel (repository area) prior to capping.
- The middle and lower reaches of the existing creek channel will be capped with a 0.5' layer of 4-inch minus rock (biotic barrier layer), overlain by a 2' layer of clean soil. Geotextile demarcation material will be placed below the biotic parrier layer, and geotextile filter fabric will be placed above the biotic barrier layer.
- The estuary area is assumed to be clean and will be used as the borrow area for additional cap material. The City of Bellingham (COB) estimates the estuary will have a 1-acre footprint.
- Assume construction duration of 12 weeks.
- Surveying:
  - Pre-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 3 office days.
  - Surveying during construction: assume 2-man crew for 24 field days (2 days per week) and 2-man crew for 12 office days.
  - Post-construction surveying: assume 3-man crew for 3 field days and 2-man crew for 5 office days.
- . Total area to clear and grub (per AutoCAD) = existing creek channel (upper reach) excavation area + existing creek channel (lower reach) excavation/cap area + area downstream of box culvert excavation area + existing creek channel  $(middle\ reach)\ cap\ area+historical\ creek\ channel\ removal\ action\ area+new\ creek\ channel\ excavation\ area\\ (clean\ portion)+borrow\ area\\ (estuary\ area)=1,414\ SF+12,437\ SF+1,116\ SF+32,875\ SF+54,261\ SF+(44,416+11,438)\ SF+11,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF+1,116\ SF+32,875\ SF$ acre = 201,517 SF (4.63 acres).
- 5. Clear and grub: assume 1.25 acres light trees to 6" diameter; remaining 3.38 acres light brush.

6. Total contaminated material excavation volume (per calculations) = existing creek channel (upper, middle and lower reaches) excavation volume + area downstream of box culvert excavation volume + historical creek channel excavation volume + upper creek channel excavation volume (extra volume excavated for channel below delineated contamination) = 601 CY + 380 CY + 6,979 CY + 110 CY = 8,070 BCY (bank, in-place; to be placed within the middle reach of the existing creek channel).

- 7. Assuming a swell factor of 15% for hauling and material placement, resulting loose volume = 9,281 LCY (loose, excavated).
- 8. Total contaminated material excavation area (per AutoCAD) = existing creek channel (upper reach) excavation area + existing creek channel (middle reach) excavation area + existing creek channel (lower reach) excavation area + area downstream of box culvert excavation area + historical creek channel excavation area = 1,414 SF + 3,158 SF + 1,872 SF + 1,116 SF + 53,844 SF = 61,404 SF (6,823 SY).
- 9. Total contaminated material excavation perimeter (per AutoCAD) = existing creek channel (upper reach) excavation and area downstream of box culvert excavation perimeter + existing creek channel (lower reach) excavation perimeter + historical creek channel and existing creek channel (middle reach) excavation perimeter = 365 ft + 261 ft + 2,595 ft = 3,221 ft.
- 10. New creek channel excavation volume (clean portion; per calculations) = 6,715 BCY (to be used as backfill and cap material). Loose volume = 6,715 BCY x 1.15 = 7,722 LCY.
- 11. New creek channel excavation area (clean portion; per AutoCAD) = 44,416 SF + 11,438 SF = 55,854 SF.
- 12. Borrow source (estuary area) excavation volume (per calculations) = 6,218 BCY (additional cap material needed). Loose volume = 6,218 BCY x 1.15 = 7,151 LCY.
- 13. Total cap area (per AutoCAD) = existing creek channel (middle reach) cap area + existing creek channel (lower reach) cap area = 32,875 SF + 7,407 SF = 40,282 SF (4,476 SY).
- 14. Assume soil excavated from the new creek channel (clean portion) will be stockpiled onsite for use as backfill and cap material. 15. Assume a water diversion system will be in place during capping and excavation in the lower portion of the site: the system will consist of a pump behind an earthen dam at the upstream end of the earthwork, from which water will be
- pumped through a hose to a settling pond at the downstream end of the earthwork. 16. Total backfill/cap soil material volume = 7,722 LCY + 5,310 LCY = 13,032 LCY.
- 17. Total backfill/cap area = 6,823 SY + 4,476 SY = 11,299 SY.
- 18. For capping of the middle and lower reaches of the existing creek channel, assume a 6-inch layer of 4-inch minus rock will be placed.
- Volume of 4-inch minus rock needed = 40,282 SF x (6/12) ft = 20,141 CF (746 CY).
- Assume 4-inch minus rock density = 1.4 tons/CY; therefore, 1,044 tons 4-inch minus rock needed.
- Assume 4-inch minus rock material imported and stockpiled at the LSC Site at a location to be determined.
- 19. For restoration of the new creek channel, assume a 3-inch layer of habitat mix material (sand/gravel of a particular gradation) will be placed along the entire channel. For restoration of the existing creek channel (remaining backfilled/capped rea) and estuary area, assume the entire area will be revegetated
  - Habitat mix area (per AutoCAD, approx.) = 78,213 SF (8,690 SY).
  - Volume of habitat mix material needed = 78,213 SF x (3/12) ft = 19,553 CF (724 CY).
  - $Assume \ habitat \ mix \ material \ density = 1.3 \ tons/CY; \ therefore, 941 \ tons \ habitat \ mix \ material \ needed.$
  - Assume habitat mix material imported and stockpiled at the LSC Site at a location to be determined.
  - Total area to be revegetated = 1,414 SF + 1,116 SF + 32,875 SF + 7,407 SF + 1 acre = 86,372 SF (1.98 acres).
- 20. Wetland Restoration/Mitigation:
  - Area of impacted wetlands = 1.5 acres (per AutoCAD, approx.).
  - Assume a mitigation ratio of 1:1.5.
  - Assume mitigation will be onsite at a cost of \$70,000 per acre. This cost is based on wetland construction costs at other sites.
- 21. For construction oversight and onsite analytical testing:
- Assume two oversight engineers (one for 40 hours per week, and one for 20 hours per week for 12 weeks); one chemist to perform onsite field screening (20 hours per week for 12 weeks); one project engineer (10 hours per week for 12 weeks); and one chief engineer (5 hours per week for 12 weeks).
- 22. Onsite field screening:
  - Pre-excavation, assume soil/sediment samples (using a hand auger) will be collected for field screening to better delineate the extent of contamination. 20% of the total will be confirmed by an offsite lab.
- Contamination delineation samples (soil/sediment): assume one sample location per 625 SF (25 ft x 25 ft area) of excavation area = 61,404 SF/625 SF = 98 sample locations. Assume three samples per sample location = 294 samples. Assume 310 samples total.
- 23. Offsite lab analysis:
  - Contamination delineation confirmation samples (soil/sediment): 20% of 310 samples = 62 samples.
  - Bottom of excavation confirmation samples: assume one sample per 625 SF (25 ft x 25 ft area) of total excavation area = 61,404 SF/625 SF = 98 samples. Assume 210 samples total. - Sides of excavation confirmation samples: assume one sample location per 25 ft of total excavation perimeter = 3,221 ft/25 ft = 129 samples. Assume 140 samples total.
- 24. Annual Post-Removal Site Control (PRSC) costs:
  - Calculated per EPA FS Guidance using the present value analysis method with a discount rate of 7% and a 30-year analysis period.

	0,557	* * * * * * * * * * * * * * * * * * * *	TARAF	E02325	3.6000	UNIT	TOT: *	P. 6
Description	QTY	UNIT	LABOR	EQUIP	MTRL	TOTAL	TOTAL	Reference
GENERAL								
Plans and Submittals Construction Operations Plan, Quality Control Plan, and Safety Plan		LS					\$10,000	Engineering Estimate
		LS						Engineering Estimate
Subtotal							\$10,000	
Pre-Construction Surveying			A4 - 5 - 5 - 4	***		A4 505	07.212	Trace c
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	3	Day	\$1,015.12			\$1,015.12	\$3,045	HCCD Crews
Subtotal							\$8,300	
Surveying During Construction					1			
HCCD Crew A-7, 2-man field	24	Day	\$1,015.12	\$80.97		\$1,096.08	\$26,300	HCCD Crews
HCCD Crew A-7, 2-man office	12	Day	\$1,015.12			\$1,015.12	\$12,181	HCCD Crews
Subtotal							\$38,500	
Post-Construction Surveying						. L	, ,	
HCCD Crew A-7, 3-man field	3	Day	\$1,656.51	\$80.97		\$1,737	\$5,212	HCCD Crews
HCCD Crew A-7, 2-man office	5	Day	\$1,015.12	,		\$1,015.12	\$5,076	HCCD Crews
Subtotal			. ,			, ,	\$10,300	
Quality Control During Construction							φ10,500	<u> </u>
Quality Control (e.g., compaction testing)		LS					\$15,000	Engineering Estimate
		L					•	Engineering Estimate
Subtotal							\$15,000	
MOBILIZATION/DEMOBILIZATION	12	WK	¢2.925			¢2.925	¢24.010	HCCD 01 21 12 20 0200
Site Superintendent	12	WK	\$2,835 \$607			\$2,835 \$607	\$34,018 \$7,283	HCCD 01 31 13.20 0260
Clerk								HCCD 01 31 13.20 0020
Project Manager	12 12	WK	\$3,074			\$3,074	\$36,893	HCCD 01 31 13.20 0200
Field Engineer		WK	\$1,861	#279		\$1,861	\$22,327	HCCD 01 31 13.20 0120 HCCD 01 52 13.20 0350
Frailers (incl air conditioning) - 2	6 12	MO WK		\$278		\$278 \$200	\$1,670 \$2,400	Engineering Estimate
Electric Install	2	EA				\$150	\$300	
Felephone - 2 lines	24	WK				\$100	\$2,400	Engineering Estimate Engineering Estimate
Portable Toilet - 2	6	MO		\$197.51		\$100	\$1,185	HCCD 01 54 33 40 6410
Field Office Expenses	6	MO		\$179.03		\$179	\$1,074	HCCD 01 54 33 40 0410 HCCD 01 52 13.40 0100
<u> </u>	0	WIO		φ177.03		Ψ172		11000 01 32 13.40 0100
Subtotal							\$109,600	
EXCAVATION								
Clear and Grub	1.25	T .	Φ2.555.26	Φ1 501 50		<b>#4.057</b>	Φ5.051	HGGD 21 11 10 10 0020
Cut and chip light trees to 6" diameter	1.25	Acre	\$2,555.36	\$1,501.50		\$4,057	\$5,071	HCCD 31 11 10.10 0020
Grub stumps and remove	1.25	Acre	\$670.78	\$1,114.58		\$1,785	\$2,232	HCCD 31 11 10.10 0150
Clear light brush with dozer	3.38	Acre	\$466.35	\$623.70		\$1,090	\$3,684	HCCD 31 13 13.10 0300
Subtotal							\$11,000	
Excavation of New Creek Channel (Clean Portion) and Stockpiling for U	Jse as Backf	ill/Cap Ma	aterial					
Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY	6,715	BCY	\$0.72	\$1.04		\$1.76	\$11,806	HCCD 31 23 16.42 0260
apacity	0,713	DC1	Ψ0.72	Ψ1.01		Ψ1.70		
For loading onto trucks, add 15%							\$1,771	HCCD 31 23 16.42 0020
Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. wait/load/travel/unload	7,722	LCY	\$1.21	\$1.84		\$3.05	\$23,555	HCCD 31 23 23.20 1014
Front end loader, wheel mounted, 3 CY bucket - for stockpile management	7,722	LCY	\$0.54	\$0.35		\$0.89	\$6,869	HCCD 31 23 23.25 6045
Subtotal							\$44,000	

Table D6. Cost Estimate for Alternative 5: Excavation, Consolidation, Capping, and Long Creek Reroute back through the Historical Creek Channel Excavation of Contaminated Areas and Placement Within Middle Reach of Existing Creek Channel (Repository) Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY 8.070 BCY \$0.72 \$1.04 \$1.76 \$14,189 HCCD 31 23 16.42 0260 capacity For loading onto trucks, add 15% \$2,128 HCCD 31 23 16.42 0020 Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. HCCD 31 23 23.20 1014 9,281 LCY \$1.21 \$1.84 \$3.05 \$28,308 wait/load/travel/unload Front end loader, wheel mounted, 3 CY bucket - for contaminated material 9,281 LCY \$0.54 \$0.35 \$0.89 \$8,255 HCCD 31 23 23.15 6045 Compaction - riding, vibrating roller, 6" lifts, 2 passes 9,281 LCY \$0.24 \$0.18 \$0.42 \$3,938 HCCD 31 23 23.23 5000 \$56,800 Diversion of Water During Capping and Excavation in the Lower Portion of the Site 4" diaphragm pump - pumping 8 hrs, attended 2 hrs/day, incl. 20 LF suction Day \$182.07 \$27.14 \$209.21 \$2,929 HCCD 31 23 19.20 0650 hose and 100 LF discharge hose \$2,900 Excavation from Borrow Area (Estuary Area) (loading, hauling and placement included in following section) Excavating, bulk bank measure - excavator, hydraulic, crawler mtd., 2 CY \$1.04 \$1.76 \$10,932 HCCD 31 23 16.42 0260 \$10,900 Subtota Backfill of Excavated Contaminated Areas (Upper, Middle and Lower Reaches of Existing Creek Channel and Area Downstream of Box Culvert) and Clean Soil Placement for Cap (Middle and Lower Reaches of Existing Creek Channel) Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto 14,873 \$13,230 HCCD 31 23 23.15 6045 Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. 14,873 LCY \$1.21 \$1.84 \$3.05 \$45,366 HCCD 31 23 23.20 1014 wait/load/travel/unload Spread dumped material - by dozer, no compaction 14,873 LCY \$0.73 \$1.25 \$1.98 \$29,479 HCCD 31 23 23.17 0020 11,298 \$0.11 \$9,093 HCCD 31 22 16.10 3300 Finish grading slopes, gentle SY\$0.69 \$0.80 Compaction - riding, vibrating roller, 6" lifts, 2 passes 14,873 LCY \$0.24 \$0.42 HCCD 31 23 23.23 5000 \$0.18 \$6,312 \$103,500 Subtotal CAPPING (Note: soil placement is included in preceding section) Geotextile demarcation material - for placement between contaminated 4,476 SY \$0.38 \$1,701 Vendor Quote material and biotic barrier layer Geotextile filter fabric - for placement between biotic barrier layer and clear 4,476 SY\$0.58 \$2,574 Vendor Quote \$4,300 Subtota 6-Inch Biotic Barrier Layer 4-inch minus rock, stockpiled onsite 1,044 Ton \$7.85 \$8,199 Vendor Quote Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto \$0.54 \$0.35 HCCD 31 23 23.15 6045 746 CY\$0.89 \$664 dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. HCCD 31 23 23.20 1014 746 CY \$1.21 \$1.84 \$3.05 \$2,275 wait/load/travel/unload Spread dumped material - by dozer, no compaction HCCD 31 23 23.17 0020 746 CY\$0.73 \$1.25 \$1.98 \$1,479 HCCD 31 22 16.10 3300 Finish grading slopes, gentle 4,476 SY \$0.11 \$0.69 \$0.80 \$3,602 \$16,200 Subtotal RESTORATION 3-Inch Habitat Mix Layer Within Creek Channel 941 Habitat mix material, stockpiled onsite Ton \$11.35 \$10,683 Vendor Quote Front end loader, wheel mounted, 3 CY bucket - load from stockpile onto \$0.35 HCCD 31 23 23.15 6045 724 CY\$0.54 \$0.89 \$644 dump truck Hauling - 12 CY dump truck, 15 mph average, 0.5 mile cycle, 15 min. 724 CY\$1.21 \$1.84 \$3.05 \$2,208 HCCD 31 23 23.20 1014 wait/load/travel/unload Spread dumped material - by dozer, no compaction 724 CY\$0.73 \$1.25 \$1.98 \$1,435 HCCD 31 23 23.17 0020 8,690 SY\$0.11 \$0.69 \$0.80 \$6,994 HCCD 31 22 16.10 3300 Finish grading slopes, gentle \$22,000 Subtota Revegetation Seeding 1.98 \$1,700 \$3,366 Vendor Quote Acre \$500 1.98 Acre \$990 Fertilizer Vendor Quote \$4,400 Subtota Wetland Restoration/Mitigation Acre \$70,000 \$157,500 **Engineering Estimate** Total cost to restore/mitigate wetlands Subtotal \$157,500 CONSTRUCTION MONITORING Construction Oversight 720 HR \$85.00 \$61,200 **Engineering Estimate** Oversight Engineers Senior Chemist 240 HR \$90.00 \$21,600 Engineering Estimate HR \$120.00 \$14,400 Project Engineer 120 Engineering Estimate Chief Engineer HR \$150.00 \$9,000 Engineering Estimate \$106,200 Analytical Testing - Onsite Field Screening (soil/sediment) RaPID ® PCP Test Kits (50 tests per kit) Kit \$830 \$5,810 Vendor Quote RaPID ® PAH Test Kits (50 tests per kit) \$11,725 \$1,675 Kit Vendor Quote RaPID ® Carcinogenic PAH Test Kits (50 tests per kit) Kit \$1,675 \$11,725 Vendor Quote RaPID ® PCP Extraction Kits (12 tests per kit) 26 Kit \$185 \$4,810 Vendor Quote RaPID ® PAH Extraction Kits (12 tests per kit; same extraction kit for Vendor Quote 26 Kit \$185 \$4,810 cPAHs) Rental: SDI RaPID ® Accessory Kit MO \$2,200 \$4,400 2 Vendor Quote Subtotal \$43,300 Analytical Testing - Offsite Lab for Confirmation Testing PAHs (EPA Method 8270 SIM) 412 Test \$165 \$67,980 Vendor Quote PCP (EPA Method 8151) 412 Test \$145 \$59,740 Vendor Quote Dioxin/Furans (EPA Method 8290) 412 \$278,100 Vendor Quote Test \$675 Deliverables (EDD and Hardcopy) Vendor Ouote LS \$60,873 CONSTRUCTION SUBTOTAL \$1,241,400 EPA FS Guidance \$310,400 Construction Contingend SUBTOTAL W/CONTINGENCY (DIRECT CAPITAL COST) \$1,551,800 % \$93,200 EPA FS Guidance Project Managemen \$186,300 EPA FS Guidance Removal Action Design 12 % \$124,200 EPA FS Guidance Construction Management % SUBTOTAL (INDIRECT CAPITAL COST) \$403,700 CONSTRUCTION TOTAL (TOTAL CAPITAL COST) \$1,955,500 ANNUAL POST REMOVAL SITE CONTROL (PRSC) Maintenance of repository/cap for 30 years Engineering Estimate ANNUAL PRSC SUBTOTAL \$3,500 25 \$900 EPA FS Guidance Annual PRSC Contingency

# References:

TOTAL FOR CONSTRUCTION AND ANNUAL PRSC

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER Directive 9355.0-75 (EPA FS Guidance)

SUBTOTAL W/CONTINGENCY

Project Management

ANNUAL PRSC TOTAL

Technical Suppor

\$4,400 \$400

\$700

\$5,500

\$1,961,000

EPA FS Guidance

EPA FS Guidanc

R.S. Means, 2009, Heavy Construction Cost Data 23rd Annual Edition (HCCD).